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editor's letter

I'm genuinely thrilled to be able to announce that we've struck up a new partnership: Passive House Plus is now an official partner magazine of the International Passive House Association (iPHA). Formed by the Passive House Institute to advance the passive house standard worldwide, iPHA's reach spans continental Europe and beyond, including affiliate organisations as far afield as North America and Australasia. Thanks to this partnership, all members of iPHA globally will have access to Passive House Plus – print versions in the UK and Ireland, and digital versions everywhere else, including galleries of beautifully drawn construction details of many of the buildings featured in these pages.

Make no mistake about it: Passive House Plus will continue to come in Irish and UK editions – and continue to cover passive house and other aspects of sustainable building objectively – and the content of each issue will continue to be tailored to be as useful as possible to Irish and British designers, builders, clients and suppliers, and therefore to have a meaningful, positive influence on the buildings they make. But passive house is a global construction standard, and we can learn much from understanding how people approach passive house design – and sustainable building in general – in areas with different building regulations, different construction traditions and different climates from our own.

We also have collective imperatives, such as the responsibility to attempt to stave off and simultaneously prepare for the impacts of climate change, and the depletion of fundamental resources such as energy, water, materials and entire eco systems. In Europe in particular we have common targets, such as the deadline that only nearly zero energy buildings will be permitted by January 2021 – or by January 2019 in the case of public buildings. I'm no Eurosceptic, but I must confess I winced when I first heard the term "nearly zero energy buildings". It seemed to smack of bureaucratic compromise, of the stunting of ambitions for the sake of achieving consensus. It didn't take me long to change my mind. There's an inherent dishonesty, a sleight of hand, a cooking of the books, in the concept of a zero energy building. If you're not willing to make do without electricity and heating supply, it's not a zero energy building, irrespective of however much energy you generate, and how clean that energy is. Perhaps this wasn't the commission's intention when coining the term, but nearly zero energy building appears to acknowledge this truth.

So I was pleased by the Passive House Institute's decision to launch two new classes of certification – the nicely named Passive House Plus, as well as Passive House Premium, which add renewable energy generation without compromising on the established passive house requirements. In my view this is a smart move that will help to align passive house with Europe's nearly zero energy targets. In the absence of a nearly zero energy-compatible version of passive house, there's a real risk that people will fail to take a robust, systematic approach to producing notionally low energy buildings, leading to unnecessarily high capital and running costs, health risks and structural damage. It's a question of recognising that there is a role for renewable energy generation, but not at the expense of eliminating energy waste, or of failing to produce a comfortable, healthy, robust building.

Regards,
the editor

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Passive House Plus (Irish edition) is the official magazine of Éasca and the Passive House Association of Ireland

2012 Business magazine of the year
- Irish Magazine Awards

Jeff Colley: winner green leader award
-Green Awards 2010

Construct Ireland: winner green communications award
-Green Awards 2010

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PUBLISHERS: Temple Media Ltd.
PO Box 9688, Blackrock, Co. Dublin, Ireland
T: +353 (0)1 2107513 / +353 (0)1 2107512
Email: info@passivehouseplus.ie
www.passivehouseplus.co.uk

EDITORIAL


EDITOR:
Jeff Colley
E: jeff@passivehouseplus.ie


DEPUTY EDITOR:
Lenny Antonelli
E: lenny@passivehouseplus.ie


REPORTER:
John Hearne
E: john@passivehouseplus.ie


REPORTER:
Kate de Selincourt

CONTRIBUTORS

Simon McGuinness, *architect*
Wolfgang Hasper, *Passive House Institute*
Philip Lee, *Philip Lee Solicitors*
Zeno Winkens, *architect*


UK SALES

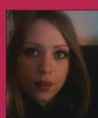
Stephen Molyneux
E: stephen@passivehouseplus.co.uk


READER RESPONSE / IT

Dudley Colley
E: dudley@passivehouseplus.ie


ACCOUNTS

Oisin Hart
E: oisin@passivehouseplus.ie


ART DIRECTOR

Lauren Colley
E: lauren@passivehouseplus.ie

PRINTING: GPS Colour Graphics,
T: 028 9070 2020
www.gpscolour.co.uk

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Cover: Meath passive house
Photograph: Archie O'Donnell

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News

Passive house conference focuses on nearly zero energy future

Photo: © iPHA

At the 2014 International Passive House Conference in Aachen, Germany, which took place on 25 and 26 April, experts from all over the world showed how current construction practices can be made fit for the future.

During the two day conference, almost one hundred expert lectures were held covering a wide range of topics, from the challenges presented by the construction of passive house buildings in different climate zones to experience gained with passive house supermarkets and indoor swimming halls, to the growing interest in passive house in North America. Particular emphasis was given to developments that will substantially influence the building sector, such as the EU Energy Performance of Buildings Directive, which calls for all new buildings to be "nearly zero energy" by 2021.

The Passive House Institute is preparing for this development with the introduction of new certification categories, passive house plus — for buildings that produce as much energy as they consume — and passive house premium, for buildings that produce more.

The UK and Ireland were both represented with strong delegations. Former European Parliament President and brand new passive house owner Pat Cox gave a plenary speech entitled "German knowhow – Irish can do" highlighting the growing Irish presence in passive house, which was represented by a stand with an Enterprise Ireland led cluster of passive house and low energy companies including Munster Joinery, the Passive House Academy, SIP Energy, ThermoHouse, and Zephair. English passive house experts Nick Grant and Mark Siddall presented respectively on internal heat gains and occupant satisfaction in passive houses, while the Green Building Store's Chris Herring & Bill Butcher presented the Stirley Community Farm barn upgrade as featured in this issue. Passive House Academy director Tomás O'Leary presented on the EU funded Europhit project.

The launch of designPH, the new 3D planning tool, was met with great excitement, especially from the designers and architects amongst the some 1,000 conference visitors. The software, based on SketchUp, allows for the 3D input of energy-relevant design data. The result can then be exported into PHPP.

"Energy efficient construction and refurbishment is getting less expensive each year and is thus becoming even more attractive for building owners," said Dr Wolfgang Feist, scientific director of the Passive House Institute. "Investing in the energy efficiency of your own building is first and foremost a question of economic sense. Improved comfort is an added benefit, as is the significant contribution to the fight against climate change."

At the opening of the conference, six buildings and one region were recognised with the 2014 Passive House Award: an apartment block in Berlin (Germany), a New York retrofit (USA), a seminar building in Goesan (South Korea), an art museum in Ravensburg (Germany), a building complex in Espoo (Finland), a terraced house in Philadelphia (USA), and an entire passive house district in Heidelberg (Germany). The awards were presented as part of the EU funded Passreg project (passive house regions with renewable energies) and further supported by the German Federal Ministry of Economic Affairs and Energy.

The next International Passive House Conference will take place from 17 - 18 April 2015 in Leipzig (Germany).

(above) Former European Parliament President Pat Cox speaking at the 2014 International Passive House Conference. The educational building award was won by a seminar and apartment building in Goesan, South Korea by ArchitekturWerkstatt Vallentin

News

Better Retrofit Partnership calls for pilots

A new partnership created to transform the UK retrofit market is calling for more social housing and solid wall building refurbishments on which to test its unique performance pledge. The pledge from the Better Retrofit Partnership covers not only energy performance but fabric durability, environmental impact, usability and occupant health and comfort.

Now founders Aereco, Baumit UK, Natural Building Technologies and Parity Projects want estate managers and social landlords to partner with them in proving the benefits of the whole house approach. They have also revealed more details of how the performance pledge in retrofit will operate.

The partnership's whole house approach is based on a four-stage process: comprehensive pre-retrofit assessment; tailored and cost-effective design and specification; approved and quality assured installation; post-retrofit construction testing and re-assessment.

According to Aereco director Pierre Lopez: "Our pledge is based on a comprehensive and wholly impartial survey, energy assessment and risk assessment at the start. This approach will allow us to develop a precisely tailored design and specification for the refurbishment, which is then delivered by our approved installers and comprehensively tested after completion.

"Performance is going to be measured using a combination of survey-based modelling and pre and post-completion testing – thermographic and airtightness. Ongoing monitoring and feedback, including internal temperature, relative humidity and occupant surveys, will also provide us with additional performance evidence. The methodology and metrics are fully declared, transparent and based upon current best practice and scientific understanding."

The partners say their confidence in offering such a comprehensive guarantee is based on a unique approach to retrofit – one they hope will prove a model for the industry and address the chronic failure of many refurbishment projects.

Parity Projects MD Russell Smith said: "There's growing awareness among a number of industry bodies that before long we will start to see the negative impacts and costs of having taken a piecemeal approach to refurbishing the UK's housing stock.

"A high percentage of current retrofit projects are not performing as expected, and worse, are actually increasing the risks to long-term fabric viability and occupant health. Measures that are widely accepted throughout the refurbishment industry consistently have damaging and unintended impacts on another."

He added: "There is a better way of working together – a whole house approach which delivers better retrofit through a holistic understanding of the relationships between energy, health, fabric, ventilation and user behaviour.

"Having a fully integrated process with appropriate quality control, right from the initial survey and specification through to post-occupancy feedback, is the only way to achieve an assured level of thermal performance, indoor air quality, fabric durability and occupant health, comfort and satisfaction."

(above) Part of the Better Retrofit Partnership's offering is a detailed survey to rule out risky interventions

Hanse Haus build 1st UK passive bungalow

Leading German pre-manufactured house builder Hanse Haus recently completed their first ever passive house bungalow in Inverness, Scotland.

The property is a highly specialised, ultra-low energy bungalow; one of only a handful of passive house bungalows in the UK, or anywhere in Europe. Hanse Haus say it is "the first of its kind to adhere to the strict construction requirements of the Passive House Institute in Darmstadt, Germany in order to gain official certification".

According to Hanse Haus the bungalow utilises "state of the art insulation, air ventilation with heat recovery and electronic controlled external shading". Such is the airtightness of the structure that the bungalow scored an impressive 0.23 air changes per hour, on testing, when depressurised.

"Having performed countless airtightness tests throughout the Highlands of Scotland, the results from the Hanse Haus passive house bungalow in Inverness were among the best we've ever seen," said Angela Craig, manager at Pentland Energy.

Photos: © Scottish Provincial Press/Gary Anthony

Homeowners Tony and Jean Hills estimate their heating costs will be £140 per year or less now.

Their preferred ambient room temperature is 21C. "Without the underfloor heating even being turned on, [that] is very easy to achieve from body heat, shower heat, cooking heat and solar gain," said Tony, adding that the underfloor heating has only been used in the depths of the Scottish winter, when a cold wind is blowing. The three bedroom bungalow in Inverness has open-plan kitchen, dining and living spaces.

"We have days when we have the windows and doors open to cool our home down, but have yet to have the automatic solar blocking shutters on our main south facing windows come down, and need to calibrate them better, said Tony. "What we do have thanks to the Passivhaus Trust and Hanse Haus is a brilliant, stunning, comfortable home which we are so proud of."

(above) Tony and Jean Hills estimate their certified passive house in Inverness is costing circa £140 per year to heat

News

Advantage Austria announces low energy seminars

Advantage Austria, the UK office of the Austrian trade promotion organisation, is pleased to announce the launch of a series of CPD oriented technical workshops and networking sessions to promote education in and deliver practical knowledge of low energy buildings.

Aimed at practitioners including low energy and passive house designers, contractors and installers, quantity surveyors and engineers, the initial workshop will take place in London on 18 June, with further workshops planned in the autumn around the country.

The event on the evening of 18 June will take place in the Austrian Trade Commission in London and will focus on value engineering of passive house and low energy techniques for the UK market. Each workshop will include technical presentations by three or four leading Austrian low energy technology companies, with ample opportunity to engage with speakers and other delegates before and after the presentations.

Advantage Austria is a founder member of the UK's Passivhaus Trust and is engaged in promoting sustainable technologies and bringing together experts in UK and Austrian low carbon building and sustainable development.

"Austria was one of the first countries to recognise the importance of low energy building design for a sustainable future and has the highest density of passive house buildings in Europe. We are delighted to see the speed and enthusiasm with which the UK has embraced energy efficient building in the last few years. We are proud that many of our most innovative Austrian companies in this field have been able to work with UK partners to further this trend and hope that this cooperation continues to bear fruit in the future," said Georg Karabaczek, Austrian trade commissioner in London.

Among the companies taking part in the event in London on 18 June are Optiwin, Isocell and Green Tomato Energy. Window manufacturer Optiwin produces "high specification, precision engineered passive house, low energy windows & solar facades" and won three prizes in the inaugural Passive House Component Awards announced at the International Passive House Conference on 25-26 April in Aachen, where Advantage Austria exhibited. Optiwin's projects include both Ireland's and England's first passive houses and Ireland first's commercial passive building. Isocell is a specialist in tapes, membranes and other products for achieving airtightness and windtightness, and also specialises in cellulose fibre insulation and blowing equipment.

Meanwhile, Green Tomato Energy is a firm of low energy designers based in London that has worked on various passive house and Enerphit upgrade projects.

To register your interest for the event in London on 18 June or for future events please contact Peter Franklin at Advantage Austria on London@advantageaustria.org

Pictured (l-r) Optiwin Bieber-Bois CEO Christophe Bieber, Optiwin's UK head of operations Conor Ryan holds Optiwin's three passive house component awards, Optiwin's head of technical operations Dennis Kuhn, Passive House Institute founder Dr Wolfgang Feist, Optiwin Gnan Fensterbau's Ferdinand Stocker and Passive House Institute senior scientist Dr Benjamin Krick

Xtratherm launches Y-Value Calculator

Xtratherm has launched a new online tool designed to enable architects, energy assessors and designers to take full advantage of good detailing based on the Accredited Details for Construction (ACDs). The Xtratherm Y-Value Calculator is an "easy to use" tool to determine the thermal bridging heat loss from non-repeating thermal bridges that must be accounted for in SAP 2009 and SAP 2012.

Xtratherm's technical manager Danny Kearney said: "With the changes to the new Part L and the drive towards low energy buildings, insulation performance can no longer be measured in terms of U-values alone. How that insulation joins with other components in the build and at building junctions, is a critical factor in insulation effectiveness, which in SAP is measured as the Y-value. With the Y-Value Calculator we offer additional support to the building industry by making it easier to calculate the thermal bridges in a design. Within Part L greater focus is placed on improving good detailing, which – if done effectively – makes a significant difference in obtaining the desired energy ratings."

The calculator tool is now available online and allows users to calculate the Y-value by entering data from existing SAP calculations or directly from drawings by adding the length of each thermal bridge along with the total heat loss area of the building. Adding each junction as per table K1 in SAP, the tool will calculate the total Y-value of the dwelling. The results will show three different options: the default value will be the result if no particular details are used. A second option will show the result when using the accredited details, with the third option showing the Xtratherm results based on Xtratherm engineered jointed products being used.

Xtratherm said that when using its PIR insulation in the design, results will show significant improvement, as the "extremely efficient insulation material has the added benefit of engineered jointing". A full user guide has also been made available and contains further explanation on how to use the Y-Value Calculator. It also contains further reading on thermal bridging and details on how using Xtratherm insulation can improve the energy efficiency of a building.

(above) A screenshot of Xtratherm's Y-Value Calculator tool

News

Cygnum gets passive certification for timber frame system

Cygnum has become the first Irish company to achieve passive house certification for a complete building system. The Cygnum Passive 350 system is now only the second certified build system in the UK and Ireland. It includes wall, roof, and foundation details.

Passive 350 features a 300mm twin wall sheeted on both sides with 9mm OSB, with a membrane on the inside forming the airtight layer. The build-up features a 140mm cellulose-insulated stud, a 53mm thermal break, and a second 89mm insulated stud which is designed to be thermal bridge free.

Passive 350 achieves a U-value of 0.13, but this can be increased or reduced by altering the dimensions of the thermal break.

“To get this certification, we had to ensure that everything — materials, detail design and factory quality control standards — were to the highest level,” says Cygnum’s Heber McMahon.

“Four key factors had to be addressed: U-values, airtightness, thermal bridging, and interior surface temperatures. The fact that Passive 350 is certified will reduce the cost of building passive. Because all the information on this system is now included in PHPP version 8.5, a PHPP designer can literally choose the Cygnum system from dropdowns and avoid having to reinvent the wheel with a lot of initial design work. Their workload is less, and the quality is assured.”

The system is suitable for everything from large non-domestic projects to one-off passive houses.

Cork-based Cygnum has already built two passive house certified schools in the UK and is currently working on more. The company is building a new passive house archive and records centre for Herefordshire Council and will start work later this summer on another passive building at the University of East Anglia.

Photo: Andrew Bradley

(above) Cellulose insulation being blown into a Cygnum timber frame panel in their Cork factory

Ecological Building Systems launches new airtightness tapes

Leading airtightness solutions company Pro clima has expanded its range of tapes with the launch of the new Extoseal range, which includes Extoseal Encors, Extoseal Magov and Extoseal Finoc.

Extoseal Encors features a unique acrylate butyl adhesive glue, which is designed to provide the optimum combination of acrylate glue reliability combined with the sealing and adaptive properties of butyl glues. Pro clima said that unlike conventional butyl tapes, thanks to the addition of Pro clima’s acrylate, Extoseal may be applied reliably even at very low temperatures combined with high reliability even in humid conditions, as often experienced in Ireland and the UK.

Niall Crosson, technical engineer with Pro clima’s UK and Ireland distributor Ecological Building Systems, commented; "The combination of extremely high adhesive strength, water tightness and flexibility ensures Extoseal Encors provides a reliable solution in areas prone to water leakage, particularly below window sills. This is often seen as a weak point in external insulation systems. With Extoseal Encors the water tightness of the area under window sills are delivered more simply and more reliably than ever. Even in the event that nails are applied through the sill at a later stage, Extoseal Encors’s inherent ability to self-seal nail penetrations ensures water tightness is maximised.”

The Pro clima Extoseal series of butyl tapes includes Extoseal Finoc, a butyl tape with uses including acting as a capillary break directly beneath sole plates. In addition the highly flexible connection tape Extoseal Magov is designed for sealing around circular penetrations or awkward junctions.

The Extoseal range of tapes can adhere reliably to plywood, wood, plastic, metal, OSB, or even mineral/concrete substrates. Further Information and product samples can be obtained from Ecological Building Systems.

Ecological Building Systems UK has recently moved to new premises which now sees the warehousing and offices on one site on the outskirts of Carlisle, Cumbria. Penny Randell, the company’s UK general manager said: “It is an exciting period of development for us. As well as the Pro clima stock we’re now able to comprehensively stock our Gutex range of wood fibreboards ensuring a more competitive price structure than previously, more efficient logistics and quicker turnaround on stock items. Our focus is to continue to provide high technical input and support to specifiers on projects, coupled with efficiencies in our supply and distribution. Our team is also expanding and we are currently recruiting for a technical engineer – all positive steps as the market continues to develop and grow.”

Photos: Carsten Dittert

(above) Pro clima’s new Extoseal Encors and Magov tapes

News

UK & Ireland Icynene distributor wins two global awards

GMS Insulations Ltd, the Irish and UK distributor for Icynene spray foam insulation products, recently picked up two awards at the Icynene 2014 Global Conference in Cancun, Mexico. The company won the prizes for best international distributor, and best international project for the Maggie's Centre for Cancer Care in Aberdeen.

Speaking after the event, managing director of GMS Insulations Gerry Sheridan said: "These awards were the result of hard work and dedication from each Icynene contractor in the UK and Ireland and demonstrate the high quality standards maintained by each contractor. This delivers a high level of comfort and reassurance to the homeowner and end user and sets each contractor on a higher level to the market competition."

The prize was presented by Howard Deck, president and CEO of Icynene, at the global conference, which gathered hundreds of contractors and distributors from around the world.

Meanwhile Icynene has also announced the launch of Icynene Classic LD-C-70, a new higher density 100% water blown, 100% open cell foam insulation that has higher densities and better thermal qualities than the existing LD-C-50, and is ideal for condensation control and insulation values at lower depths for commercial, industrial and agricultural applications.

GMS Insulations recently opened a dedicated UK based company, Greentherm Solutions Ltd, to provide distribution and support to the growing UK contractor base. Greentherm has regional offices across the UK, and the company said its goals are to provide support to its contractor network in addition to growing the demand for Icynene in the UK.

Photo: Carlos Pasten

Pictured at the Icynene 2014 Global Conference in Cancun are (l-r) Icynene president & CEO Howard Deck, GMS Insulations MD Gerry Sheridan & Icynene vice president Randy Scott

SIP Energy gets BBA certification

Galway-based manufacturer SIP Energy has been awarded BBA (British Board of Agrément) certification for its structural insulated panel system.

SIP Energy said that its system is designed to deliver the most efficient buildings to the highest standards – including homes, schools and commercial buildings. The company's engineering, manufacturing and site works were comprehensively evaluated as part of the certification process.

The company's technical and sales director John Moylan said: "BBA certification is an industry-acknowledged benchmark of quality, and all of us at SIP Energy are proud that our system has been found to have satisfied the stringent requirements of BBA for not only the performance of our finished product but also the quality of its manufacture and erection on-site. Evaluation by BBA is thorough and demanding and covers everything from calculations and design to materials, manufacturing and site work. BBA certification gives our customers confidence knowing that the system has been objectively and comprehensively evaluated.

"As part of any certification process a comprehensive test programme for all the disciplines of modern building – structure, insulation, airtightness, acoustics and fire performance – all demonstrate to the notified body's satisfaction that SIP Energy's system delivers, and it is only having been through that process that the BBA give their imprimatur," said Moylan. "I am delighted for the staff and management of SIP Energy for all their work and commitment to the process, and it does go to show that an indigenous Galway company has proven itself to be a world leader in its field."

The award was presented at this year's Ecobuild show in London, where over 43,000 visitors visited from 121 countries, including most of the UK's top architectural practices.

John Moylan added that SIP Energy specialises in the manufacture, delivery and erection of buildings to the highest standards, with an emphasis on quality, and that the company can deliver systems to meet passive house thermal performance targets.

"With the advent of the latest building regulations and standards to come in the future – both in the UK and Ireland, SIP Energy are perfectly placed to meet and exceed your expectations," Moylan said. "So, whether you are building a school, home, extension or other building – and have an eye to maximum thermal and building efficiency – then SIP Energy in Athenry should be first on your list."

Pictured are (l-r) SIP Energy's Danny Ealing, BBA's project manager Bob Childs & CEO Claire Curtis-Thomas, SIP Energy's sales director John Moylan & managing director Micheál Quinn

News

Component Award proves passive house windows are profitable

The winners of the Passive House Institute's first ever component awards for windows were announced at the International Passive House Conference in Aachen, Germany on 25 and 26 April.

To enter the awards manufacturers offered their products at retail prices, including installation, for an example building. For each of the four categories – PVC, wood, wood/aluminium, and aluminium – the overall investment and energy costs saved in comparison with standard windows were the decisive factors.

In the wood category, the joint first place winners are the Slovenian manufacturer M Sora for their Natura Optimo XL window and the German window company Pfeffer for their Pfeffer RPS window. The Holz-2-Holz window by Freisinger-Optiwin of Austria took second place. In the wood/aluminium category, the Smartwin Compact by Lorber-pro Passivhausfenster of Austria and the Futura by Bieber-Optiwin of France finished on top, followed by Freisinger-Optiwin again, this time with the Alu-2-Holz window.

The first prize in the PVC category went to German producer Hilzinger FBS GmbH for their VADB-Plus 550 window. The Pural eco 90 by Pural GmbH and the Frame 90 WI by Raico, both from Germany, were the winners in the aluminium category. Special prizes went to German producers Passivhaus Transfer (dHPt), for their Delta Plus Cold Climate window (wood/fibreglass, synthetics), Wiegand Fensterbau, for the glazing set in the DW-plus systems (innovative glazing), and Pazen Fenster + Technik, for their Energin arctis (lowest heat losses).

The competition received 41 entries. "We are delighted at the level of active participation in the competition and congratulate the winners," said Dr Wolfgang Feist, scientific director of the Passive House Institute. "Overall cost savings of more than 25 percent, spread over the life span of the winning products, are possible. With passive house quality products, the energy revolution becomes not only affordable, but even profitable."

"Energy efficient, high quality components are an essential building block for the success of passive house. It is important that these products provide not only convenience and comfort, but also economic advantages. We have proven this with this award," says Dr Benjamin Krick, head of component certification at the Passive House Institute.

Photo: © iPHA

(above) Passive House Institute director Dr Wolfgang Feist, pictured at the International Passive House Conference in Aachen, where the winners of the inaugural Passive House Component Awards were announced.

Aim for high seasonal performance factor — Heliotherm Heat Pump Technologies

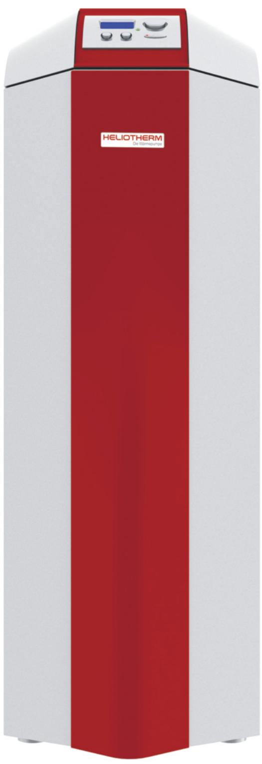
Leading Austrian heat pump manufacturer Heliotherm has advised those considering the installation of a heat pump to carefully consider the unit's seasonal performance factor (SPF).

SPF is the measured efficiency of a heat pump at a variety of temperatures over a particular heating period (such as a year or month), as opposed to co-efficient of performance (COP) which is the performance of a heat pump at set temperature conditions.

Heliotherm has the highest SPF of any heat pump listed on the Sustainable Energy Authority of Ireland's Harp database, with an SPF of 5.6 for a water-to-water unit.

Real life installations can achieve even higher efficiency, according to the company. Heliotherm achieved the highest SPF in long-term tests carried out by the Fraunhofer Institute, Germany under the EU's Sepemo project.

This ground source heat pump was monitored during 2011 and 2012 in a one-off house in Nebelberg, Austria, and achieved an average seasonal performance factor of 7.29. The house has a specific heat load of 48 W/m^2, and the Heliotherm system was designed to provide space heating with a supply temperature of 30C and a return temperature of 25C to floor and wall heating pipes. In practice the average supply temperature was 26.4C and the average return temperature was 22.8C.



The final report noted that the system worked without any malfunctions and reached a "remarkably high performance factor".

"Skyrocketing energy prices are a fact. Installing a high efficiency heat pump is therefore convenient for economical heating, cooling and warm water production in new and renovated buildings," said Heliotherm's Christian Allinger.

"The high efficiency is reached through many years of experience, qualitative investigation and development."

In the UK and Ireland, Heliotherm sells and installs its products through trained competence partners who offer a one-stop-shop service including consultation planning, installation, commissioning and maintenance. Free consultation sessions are available.

See heliotherm.co.uk for more information.

(left) Heliotherm confirm their heat pumps can generate more than 80% free energy from natural resources

News

Affordable housing provider adopts LoftZone system

Affordable housing organisation Guinness South has installed the LoftZone insulation protection and safe access system in 65 of its properties in south London.

The work was done in conjunction with a re-roofing contract and was managed by Lakehouse Contracts Ltd. In addition to the standard LoftZone deck, handrails and toe-guards were fixed alongside the deck, for additional safety.

LoftZone has developed a raised decking for lofts, which protects insulation from compression, while allowing safe access for workers. Recent research by the National Physical Laboratory and Carbon Trust has shown that loft insulation is compressed in most UK houses, and that this reduces its effectiveness by 50-60%. The LoftZone raised decking won best new invention 2013 at the Ideal Home Show in London.

Chris Wait, head of programme and planning at Guinness South, was pleased that the LoftZone loft decking product had come onto the market. He said: "We find that there's a lack of knowledge out there about the importance of protecting loft insulation, as it doesn't perform as well if it's squashed. The LoftZone platforms provide that protection and they also provide safe access routes to components that need repairing, such as water tanks. We intend to continue using the systems when replacing roof coverings.

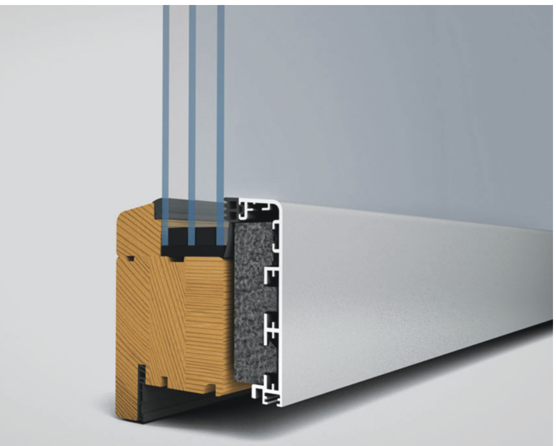
"Increasingly there is more and more need to enter lofts to maintain equipment there. Safe access is something that we take very seriously, but until we saw the LoftZone product, there was no easy way to provide this without compromising on the insulation.

"Guinness South is on the lookout for innovations that help our customers and increase safety. LoftZone's products do both."

Paul Gooch, business development director of LoftZone, said: "LoftZone's raised decking will be popular as it is the only way to meet Parts K, L and P of Building Regulations, as well as the Working at Heights safety directive."

LoftZone said that while new changes to Part L mean that raising a loft with timber for an access platform would ordinarily require redoing SAP calculations because of new thermal bridges through the timber, using LoftZone's system will avoid this.

Solarlux offers "lowest U-value bi-folding door in the UK market"



Solarlux, a market leader in glass door and glass element technology, has introduced the SL 97, which it described as a "revolutionary glass folding door with the lowest U-value in the UK market today".

The SL 97 provides "optimal thermal insulation and is the ideal solution for future building regulations and carbon reduction". This triple-glazed door features laminated wood profiles 96mm in depth. Surpassing the current building standards of 1.5, SL 97 bi-folding doors achieve passive house levels of energy performance with a U-value of 0.80.

Solarlux said the SL 97 is not only energy efficient, but also eco-friendly, using water-based glazes and sustainable materials. The company said that each component is rigorously tested to ensure it is environmentally friendly; parts are mechanically connected to each other so they can be separated easily for recycling. All wood is FSC or PEFC certified and the timber framework can be responsibly sourced from sustainable forests at the customers' request.

(left) A section view of the Solarlux SL 97 thermally broken bi-folding door

Booking now open for UK Passivhaus Conference

Booking is now open for the 2014 UK Passivhaus Conference, which takes place at the Stevenage Arts & Leisure Centre in Hertfordshire on Thursday, 16 October.

Tickets are available for £220, with discounts available for Passivhaus Trust partner organisations and members. Early bird tickets are currently available and offer a 10% discount on these prices.

See ukpassivhausconference.org.uk for more details. The provisional conference schedule includes sessions looking at the best projects of 2014, the role of passive house in meeting targets for nearly zero energy buildings and in-depth project case studies.

Meanwhile the UK Passivhaus Awards will be held on 1 July, but submissions have now closed. There are three category awards this year: architectural design, sponsored by Munster Joinery; cost & build-ability, sponsored by Saint-Gobain; and performance and user feedback, sponsor to be confirmed.

News

Green Unit launches new passive prefab

Oxfordshire company Green Unit has developed a new prefabricated, modular low rise building built to passive house specifications using natural and sustainable materials. "The result is a super-insulated and highly energy efficient building that delivers an affordable and inspiring space across a range of standard and bespoke configurations," said the company's director Jonathan Finnerty. The Green Unit is ideal for residential, educational, commercial and retail uses.

After three years of research and development Green Unit is now being launched to the market. Green Units are timber engineered barrel vaulted structures and have a living green roof supplied by Eco Green Roofs. Green roof supplier Keith Hills said: "The Eco Green Roof we designed and supplied to Green Unit is uniquely visible from the ground which places it firmly in the natural environment, whilst providing an additional 15% incremental insulation over and above other more conventional well insulated roofing systems."

Among the building's many insulating layers are 220mm of Thermafleece TF35 wool insulation and triple-glazing units supplied by Fakro. Green Unit also believe that the structure itself stores more carbon than is used during construction. The three years of R&D at Green Unit incorporated a wide range of designers and professionals, from architects and engineers to furniture designers.

"We find that whilst our architects use CAD to connect a design to its built location, our furniture makers use CAD to define components and sustainable production processes making the whole project possible," said Finnerty. "It is at this level that sustainable and eco-friendly practices are built in to our modular building system. Indeed, passive house principles such as airtightness and super insulation are put in place at exactly this detailed level of the design process. The building could neither be passive, or truly green and sustainable without this focus."

Green Unit is working with BRE towards passive house certification and with Oxford Brookes University for the practical testing of the building's thermal efficiency. Adam Tilford at BRE explained: "Passive house is easiest to achieve where the building has a compact form, ie a cube. Single-storey buildings are inherently harder to make comply than houses – which generally have a more compact form. The available floor area against which the total heating demand is normalised is also unfavourable in the Green Unit building because the wall curves in at the bottom, thus reducing the available floor area by more than 10% compared to walls that dropped vertically from the widest point."

The Green Unit show building is now available for viewing, see www.greenunit.co.uk

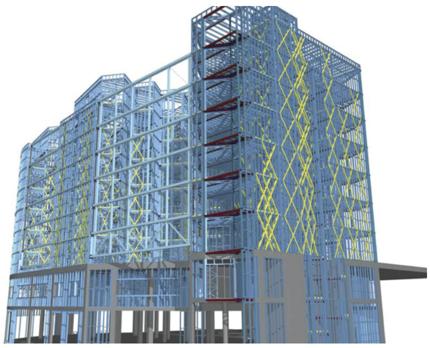
Steel framing ideal for passive house — Metcon SBS

Kent-based Metcon Sustainable Building Systems has advised anyone looking to build to low energy or passive standards to consider steel framing for speed of installation, precision engineering and thermal performance.

In 2011, the company constructed a light-gauge steel framed three-bedroom dwelling in South Wales to ultra low energy specifications, and to Code for Sustainable Homes level five. Due to the nature of the former industrial site it was constructed on, it was essential that the structure be both lightweight and structurally robust to avoid potential settlement of the building.

Once on site Metcon assembled the house, made it weather-tight and clad it in less than 10 days.

The walls are insulated with an "innovative sheathing board" known as Dragonboard, which features 75mm of insulation externally, 150mm of blown fibre insulation between lightweight steel C-sections, and 35mm of insulated plasterboard internally, delivering a U-value of 0.12 in just 290mm of thickness. Windows are triple-glazed and the orientation and glazing design aims to maximise solar gain.



The roof also comprised lightweight steel framing with insulation on both the attic floor and between the rafters, making the loft a usable space. Floors can be either timber or a dry screed board or reinforced concrete.

The 100 square metre house also features MVHR, photovoltaics and solar thermal collectors. Space heating demand is calculated at less than 14 kWh/m^2/yr, and the airtightness result was 0.27 m^3/hr/m^2.

This construction weighed 30% less than an equivalent brick and block house, helping to reduce the costs of constructing the foundations, and minimising any potential for long-term settlement of the building.

Metcon SBS also more recently constructed what the company claim is Scotland's first light-gauge steel-framed passive house on the country's east coast. The company said its portfolio includes several commercial projects using passive house principles.

(above) Metcon's light gauge steel frame system has been used on several Code for Sustainable Homes projects

News

Schüco PV business acquired by Viessmann

Viessmann Photovoltaik GmbH has come to an agreement with Schüco International KG to take over Schüco's photovoltaics business, subject to consent from supervisory authorities. The aim of the acquisition is to extend Viessmann's product portfolio and increase its customer base. Viessmann Photovoltaik GmbH wishes to expand its business activities, especially in core European markets such as Germany, Italy, the UK and the Benelux countries.

As a company with deep roots in window and facade technology, Schüco International KG will now focus on its core expertise in this sector.

Viessmann Photovoltaik GmbH will continue to expand the knowledge base developed by Schüco over recent years, particularly its expertise in solar modules and supporting structures. Viessmann Photovoltaik GmbH is part of Viessmann's wider range of heating, cooling, microgen and climate control products.

Trade professionals can thus not only acquire Viessmann heat pumps and matching storage systems, but also complete photovoltaic system technology – from modules and inverters through to supporting structures. Heat pump controllers are already designed in such a way that they optimise usage of electricity generated in a PV system, thus reducing the volume of expensive electricity acquired from the public grid.

The Viessmann Group is one of the leading international manufacturers of heating, cooling, and climate control technology.

(above) Schüco PV panels have been added to Viessmann's broad renewable energy offering.

Work underway at east end passive house

Work is now underway on one of the first passive house dwellings in London's east end. With passive house energy advice from Accredited Passivhaus Design (APD) and contemporary design by Tectonics Architects, the three bedroom house is sited between Victorian villas near London Fields, Hackney.

APDs certified passive house designer Peter Ranken said: "It was a challenge reaching the passive house energy targets because at mid-day the house sits in the shadows of the four-storey houses to the south, and it has only two-storeys with a half-basement ground floor."

Nonetheless the house is set to meet the very low energy demands of the passive house standard through thermal bridge free construction, using externally insulated insitu concrete and CLT timber walls. Warmth is provided through the west facing triple-glazed windows and by three electric towel rails.

Meanwhile, APD said that they are still busy following up on enquiries generated at this year's Ecobuild. For first-time exhibitors, APD said they were pleasantly surprised at the interest shown in their stand, which was shared with the Passivhaus Trust. The stand included an explanation of the passive house principles of comfort and energy savings.

"Two hundred visitors, including private clients, developers and product suppliers expressed an interest in finding out more about our design and energy services and we will be returning to Ecobuild next year," said passive house designer Peter Ranken.

Accredited Passivhaus Design are now also patron members of the Passivhaus Trust, and along with other patrons, support the trust in promoting the passive house approach to building design for all building types.

Aereco names Simon Jones commercial director for UK & Ireland

Following the recent restructuring of its operations in the UK and Ireland, Aereco has announced that its country manager in Ireland, Simon Jones, has become commercial director for the company across the UK and Ireland. The UK market will now be serviced directly by Aereco in Cork.

Simon brings a wealth of knowledge with him to the UK and will be supported by a highly experienced technical team based in Ireland, with direct support in the UK managed by Peter King, Aereco's sales and operations manager there.

Jones said: "I am delighted to have taken on this new and challenging role and bring with me a first class team of engineers and support staff. The UK will continue to see the same high levels of service it has come to expect. We hope to add to this the new capacity and drive required to keep growing the business in the UK and Ireland."

Simon Jones is the current chairperson of the Irish Ventilation Industry Association and sits on the national mirror group for the recast of the Energy Performance of Buildings Directive as an industry expert. He is known for raising awareness of the importance of high quality ventilation, for campaigning for better standards of ventilation in buildings, and for bringing demand controlled ventilation to the fore in Ireland.

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New home ☐ Home renovation/upgrade/extension ☐ New commercial/public building ☐
Upgrade/extension to a commercial/public building ☐

Other (please state): ____________________

Floor area (approx. ft^2 or m^2): ____________________

Budget (approximate): ____________________

Stage (tick box)

Initial appraisal ☐ Pre planning ☐ Planning approved ☐ Pre tender ☐
Commencement notice ☐

Project imperatives (tick box)

Certified passive ☐ Near passive/low energy ☐ Indoor air quality ☐ Low running costs ☐
Low environmental impact ☐

Other (please state): ____________________

Estimated start date (please state): ____________________

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I would like my project to be considered for feature in Passive House Plus (tick box) ☐

Much achieved, more to be done: passive house training perspectives

*Thanks to EU policy on ultra low energy building, the prospects for designers & tradespeople who engage in passive house training courses are excellent, says **Wolfgang Hasper** of the Passive House Institute. But while progress in some countries has been steady, the ability of passive house to fulfil EU goals means the need for passive training is bound to grow.*

The challenges associated with the upcoming European energy efficiency targets call for increased numbers of highly skilled professionals. A whole new market opens for those, with new business and employment opportunities. Moreover, customers will have an ever closer look at the relevant competence of designers and builders.

The EU's 2020 goals and the recast Energy Performance of Buildings Directive demand greatly increased energy efficiency in buildings. Member states must implement nearly zero energy buildings by 2020. These are characterised by an efficiency first approach (hence nearly zero energy), economic rating of efficiency measures within a life cycle approach plus a substantial share of the energy demand being covered by renewable energy sources "on site or nearby".

"Passive house training could - and should - become part of the curricula in universities and vocational training centres very soon"

The passive house combined with renewable energy is a proven, robust, scientifically established and cost-effective implementation of the stipulated nearly zero energy building target and its level of energy efficiency is the lowest total cost option in a life cycle assessment.

So a large scale uptake of passive house construction can be expected in the years to come. The already accelerating growth in passive house numbers in various European countries also suggests this.

Among other factors like further improved and yet more economic passive house components, training will play a key role in making the large scale implementation of passive houses possible while maintaining the required level of quality in design and construction.

Training schemes of the Passive House Institute have been addressing the needs of architects and engineers since 2007 and, more recently, of tradespeople since 2011. Both schemes are developing very well given their respective lifespan: the number of certified passive house designers is currently approaching 4000, with already about 700 tradespeople in their wake.

The numbers of course providers are growing too, with around 60 in the designer scheme and already about 25 for tradespeople. Sets of training materials are available and with the growing number of built passive house projects the number of practically experienced trainers in the local context is rising.

This is a great success and a real achievement thanks to committed course providers, professionals eager to learn and many more who are involved in the quality assurance procedures for passive houses.

High and growing numbers of certified professionals must, however, not deceive us and lull our efforts. A statistical view on the situation in the EU countries quickly reveals that while much has been achieved, even more is left to be done.

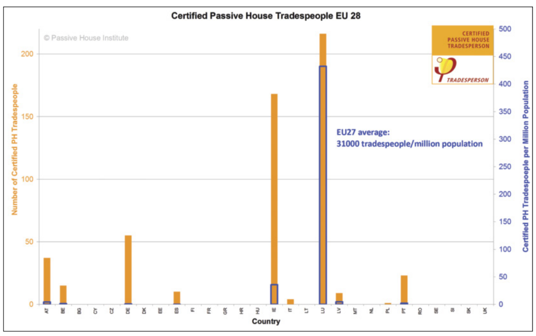
The graphs featured show the absolute numbers of designers and tradespeople respectively in all EU countries in filled columns. In addition the columns in blue outline give their relative share of the population when considering the different size of the countries.

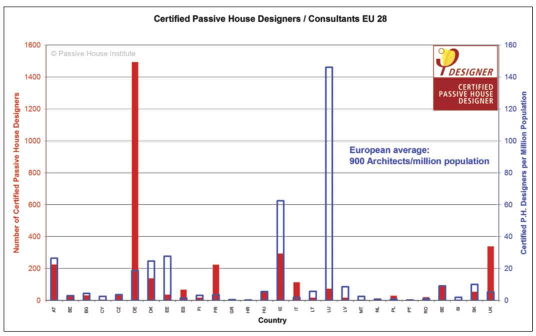
This changed perspective is quite enlightening. It reveals that the large absolute number – such as in Germany – is not very substantial when compared to the total population whereas Ireland has achieved a far greater relative number. Luxembourg even more so, but certainly this very small country presents a special case. But even Ireland has not even covered 10% of the total number of architects thus far. Even if we consider getting a quarter of all architects in touch with passive house design a realistic goal there is a lot left to be tackled.

Of course this means business opportunities for training providers, especially in countries where the development has obviously only started. In other places, we see that committed professionals were relatively easily convinced to take the training. Increasingly we all face the challenge to reach those indifferent architects and tradespeople who are not in any special way committed to passive houses but interested mainly in business. New ways need to be explored to convince those who are reluctant to change at all, be it out of mere conservatism or fear of failing to meet the required level of quality.

And let's not forget the youth. Passive house training could - and should - become part of the regular curricula in universities and vocational training centres very soon.

But there is a positive message in all of this: designing and building passive houses to the highest quality standards undoubtedly requires skills. This isn't rocket science. With some time and diligence every professional can acquire these skills and build confidence by competence. With the Energy Performance of Buildings Directive targets to meet, lots of business opportunities lie ahead.





Are minimum compliant buildings in breach of EU Law?

*If energy standards in national building regulations fall short of requirements in EU directives, asks EU law expert **Philip Lee** of Philip Lee Solicitors, where does that leave owners, developers and designers?*

The EU has adopted legislation which requires the member states to dramatically reduce energy consumption. A priority for the European Commission, reducing energy consumption via efficiency measures minimises European dependency on foreign oil imports, has a major impact on job creation, encourages innovative technology and competitiveness and is essential in the fight against climate change.

One element of an EU directive designed to address energy profligacy means that from July 2013 on, all new buildings and major renovations must meet “minimum energy performance requirements” set with a view to achieving cost optimal levels.

This provision, contained in the Energy Performance of Buildings Directive (2010/31/EU) defines “cost optimal levels” as meaning the energy performance level which leads to the lowest cost during the estimated economic life of the building, where the lowest cost is calculated looking at energy related investment costs and operating costs based on the remaining economic life of the building. The directive is not new. It was adopted in May 2010.

Having supposedly adopted the laws to establish the “minimum energy performance requirements”, member states such as Ireland & the UK were then to compare their laws using a comparative methodology framework published by the commission. The report comparing each member state’s minimum energy performance requirements to the commission comparator was to be submitted by each member state to the commission by June 2012.

Part L of the Irish Building Regulations deals with the conservation of fuel and energy for buildings and sets out our minimum energy requirements. As per changes for dwellings set out in SI 259 of 2011, Part L provides that the energy performance of the building is such as to limit the calculated primary energy consumption and related carbon dioxide emissions insofar as, is “reasonably practicable, when both energy consumption and carbon dioxide emissions are calculated using the dwelling energy assessment procedure (Deap) published by the Sustainable Energy Authority of Ireland”.

However, no effort has been made to amend Part L of the Building Regulations in respect of non-domestic buildings since 2008, long before the adoption of the Energy Performance of Building Directive in 2010.

Accordingly, it is no surprise that the March 2013 comparative report prepared for the Department of the Environment and SEAI by AECOM (which was actually due in June 2012), concludes that the Irish regulations are completely out of line with the requirement to be cost optimal. The directive provides that if there are significant discrepancies (i.e. exceeding 15%) between the minimum energy requirements adopted at national level and the commission comparator, member states should justify the difference or plan appropriate steps to reduce the discrepancy. The gap analysis showed some shocking conclusions. Even taking the maximum range for each reference building, it assessed the current Irish technical standards as 90% above the cost optimal level. However, in the case of naturally ventilated offices the cost optimal level was estimated at 52 kWh/m^2/yr. The current building regulations allow for 247 kWh/m^2/yr – almost five times such consumption levels! For air conditioned offices, the differences were in excess of 300%.

The failure to update the building regulations to reflect cost optimisation could prove a legal nightmare for architects and developers.

What is the situation for a private developer and architect who have built an office which only merely meets the current – but outdated – building regulations, and does not comply with the requirement to be cost optimal?

The first risk is the possibility that the local authority might consider the consequences of the AECOM Report and refuse to register the building under the new building control regulations. This would be a catastrophe for the developer. Would he look to his architect and ask whether he was familiar with the Energy Performance of Building Directive requirements published in 2010 for buildings to be designed to be cost optimal?

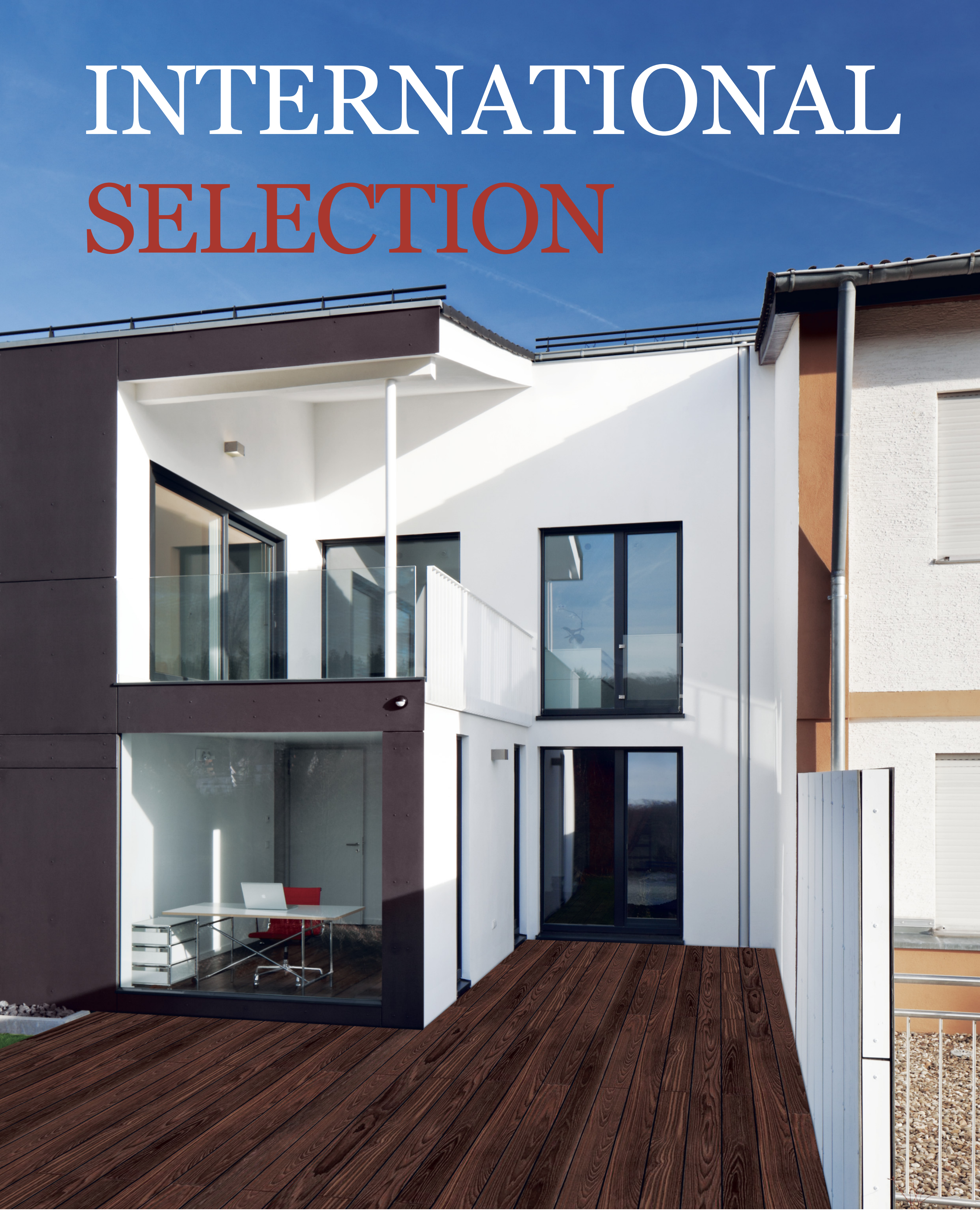
Hopefully the local authority would only have regard to the outdated Irish building regulations and allow the inefficient building to nevertheless be registered. However, what is of greater concern is the fact that the building would be outdated and could therefore prove difficult or impossible to market. International property companies, particularly those with UK experience where the building regulations for non-domestic buildings have been updated to achieve cost optimality, will be unlikely to consider purchasing or occupying such an outdated building. (Ed. – even taken at face value the UK’s cost optimality report shows that energy efficiency requirements for many building types fall short of cost optimal).

A second problem for the developer cutting the ribbon on his new building in 2014 is found in Article 6 of the European Energy Efficiency Directive (2012/27), which prohibits central government bodies purchasing buildings which do not have high energy efficiency performance. It is self-evident that a building which has only met the 2008 non-domestic building regulations will fail that test and therefore, should not be purchased or occupied by a central government body. That same directive also requires member states to encourage all other public bodies to follow an “exemplary role” in their purchase of buildings, and thus will be discouraged from occupying a building not built to the cost optimal standard. Whilst lawyers may argue over whether the phrase “purchase” includes rental, the reality is that the building developer and its design team may be sitting on a white elephant.

The Irish government has sought to implement the requirement to fulfil an exemplary role by providing in the European Communities (Energy End-Use Efficiency & Energy Services Regulations) 2009 (S.I. 542 of 2009), that from January 2012 a public body shall only purchase or lease a building for its own use which has a BER Certificate of B3 and from January 2015 a BER Certificate of A3. However there is no certainty that a B3 or A3 meets the higher standard of cost optimisation.

Of course since European law already requires all new public buildings and all new other building from end 2018 and 2020 respectively to be built to the nearly zero energy standards, the current references to A3 and B3 are of limited relevance. They are more likely to mislead – certainly to the design team currently preparing designs.

INTERNATIONAL SELECTION



This issue's Eurocentric selection is drawn from the International Isover Energy Efficiency Awards, including a German renovation that generates an energy surplus, a Danish nature reserve, a Romanian Solar Decathlon entry and a Polish church.

Photos: diephotodesigner.de

Energy + Home, Mühltal, Darmstadt-Dieburg, Germany

This renovation and extension turned a 1969 structure into a striking, modern energy positive home. Developed by a team from the Technical University of Darmstadt, along with architects Lang & Volkwein and engineers Tichelmann & Barillas, the goal was to develop a replicable retrofit that could be easily transferred to other projects.

The team insulated the original hollow block structure externally, and built a small timber frame extension too. The U-values for the upgraded walls, ground floor and roof are 0.15, 0.21 and 0.12 respectively, while the whole renovation slashed the house's space heating demand from 272kWH/m^2/yr down to 14*, just inside the passive house standard. There's also heat recovery ventilation, an air-to-water heat pump and wood pellet burner.

The final airtightness result was just 0.8 air changes per hour. In designing the upgrade, the team also increased the glazed area — all of it now triple-pane — by a whopping 160% for more solar gain and daylighting.

They also put a monocrystalline PV system on the roof, and any excess electricity is now exported to the grid. A touch panel provides easy, central control of the solar, heating and ventilation systems, as well as energy generation and consumption information. The house even charge's the family's electric car. ▶

*Though PHPP and EnEv calculations were carried out, we've been unable to clarify which software was used to generate this figure.

Photos: Adam Mørk

Nature Centre, Hindsgavl, Denmark

The Nature Centre, Hindsgavl, is an education and outdoor activity centre designed to introduce visitors to the surrounding nature reserve. The building houses teaching and exhibition spaces, offices, and other facilities for scouts, school children and other outdoor enthusiasts.

The centre was designed to meet the passive house standard, though its airtightness of 0.7 ACH is just outside the passive target. However, all the main surface U-values are 0.11 or better, and space heating is just under 15 kWh/m^2/yr. The walls feature the Isover Plus prefabricated insulation system, comprised of panels of rigid glasswool, while the Isover Vario system provides airtightness.

Designed by Danish firm AART Architects, the 450 square metre building was finished in 2012. The large glazed facades create a connection between the internal and outdoor environments, while the walls are clad with solid heartwood both internally and externally. The building also features a vegetated roof, from which visitors can enjoy extensive views of the surrounding countryside.

With solar photovoltaics on the roof, the building's net energy consumption is zero. All of which makes us wonder: while the building is designed to introduce visitors to the outdoors, might such a striking, low energy structure encourage them to stay inside instead?

Photos: Cosmin Dragomir Architecture PH

Prispa House, Romania

This small home was built by a Romanian team for the 2012 Solar Decathlon Europe, a competition that challenges university teams to build energy efficient, solar powered homes in just 13 days.

The timber frame walls, roof, and floor — which is raised off the ground — feature an unbroken layer of Isover glasswool insulation. The Isover Vario system provides airtightness, and the final test result was 0.8 air changes per hour.

Dubbed the Prispa House, the project is the result of a partnership between three different universities in Bucharest.

Its southern orientation provides a big roof space for an 8 kW photovoltaic array and two solar thermal collectors. Large sliding glass windows allow residents to open up the living space to the outdoors, while triple-glazing features throughout. The building even recycles its own greywater.

“Maximizing [the] glazed surface for daylight and minimising heat loss through the same glazed surface, is a hard-to-maintain equilibrium, but not impossible to obtain,” the designers say on their website, prispa.org.

The natural stone floor provides some thermal mass, while clay-based renders help to regulate humidity inside. There’s also an air-to-air heat pump, supplemented by infrared radiant panels.

The Solar Decathlon prototype cost €120,000, but the team hopes to get the price down to €70,000 for the mass market.

Prispa was designed to provide affordable, adaptable, energy efficient accommodation — principally for rural Romania. If sited in Bucharest, it would produce 20% more energy than it consumes.

Not bad for a house built in less than two weeks. ▶

Photos: Piotr Rayski-Pawlik

Catholic Church, Równia Szaflarska, southern Poland

Here's something you don't see every day: a passive church*. In designing the structure, architects Pasywna, Pyszczek & Stelmach, had to satisfy complex demands: the building had to be extremely energy efficient, built in a vernacular style, and provide a functioning ecclesiastical space.

The local style of architecture in this high altitude region demanded a steep roof, but this greatly increased the surface area — not ideal for meeting the passive house sandard.

The roof was built with locally sourced, low cost timber, but airtightness and thermal bridging — particular at the spire-roof junction, and around the eaves — was a challenge.

Below the roof, the main body of the building is concrete with solid masonry walls and concrete floors. Isover glasswool insulation and the Vario airtightness system were both used, and all the main building elements have U-values around 0.1.

The church is designed to hold about 500 worshippers. It also features low temperature underfloor heating, which is supplied by a geothermal heat pump drawing on deep-water wells. Airtightness is spot on the passive house target of 0.6 air changes per hour, while space heating and cooling demand is just under 14 kWh/m^2/yr. Its architects call the building a "passive church for active believers".

*The project isn't listed on the Passive House Database at http://www.passivhausprojekte.de/ and as Passive House Plus went to press the architect hadn't confirmed that the project is certified.

MIXED USE LONDON SCHEME *delivers passive at scale*

The latest in a string of passive house projects by social housing providers, Octavia's Housing's new mixed-use development at Sulgrave Gardens embraced fabric first design on an awkward London site to help protect occupants against rising fuel costs.

Words: Kate de Selincourt

Exterior photos: Morley von Sternberg; Interior photos: John Cooper

Housing associations in the UK are generally established to provide decent housing, in particular to those who would struggle to afford to buy or rent privately. With a rising population, soaring housing costs, stagnant incomes, and benefit restrictions, the need for genuinely affordable new housing in the UK is ever-increasing. The climate for developing new social housing in the UK has, however, been getting tougher.

There have been drastic reductions in the housing grant, which is intended to cover the gap between the full cost of financing new developments, and the income that can be earned from below-market rents. Although social landlords are permitted to charge up to 80% of the local market rent, to make up for some of the lost grant, many are opting not to do so, as it runs counter to their philosophy.

Some landlords are exploring alternative ways to replace the lost grant, including developing homes for private sale or shared ownership to subsidise construction of their own rental properties. One such landlord is Octavia Housing, set up in the 19th century by philanthropist Octavia Hill, and operating in some notoriously expensive areas of central London.

Last year Octavia completed a 30-unit development at Sulgrave Gardens in Shepherd's Bush, made up of four blocks comprising terraced houses, apartments and maisonettes. Eight of the new homes were built for outright sale, a number of them for over £1m. A further 13 were financed via shared ownership (which returns some capital to the landlord straight away, while making ownership more accessible to those who can only afford a small mortgage by offering a subsidised rent on the balance). The remaining nine are for tenants at the top of the local housing list.

However, although Octavia endeavour to keep rents well below the local market rate, tenants still face a financial struggle. On top of stagnant and falling incomes, the cost of basic necessities such as food and fuel have been rising. As Octavia's project manager David Callachan explains: "Even though we believe our rents are genuinely affordable by our tenants, there is still the question of how much disposable income there is left after paying rent and fuel bills -- whether they can truly feed their families."

This is where passive house comes in. Two of the four blocks at Sulgrave Gardens are aiming for passive house certification (one is already certified at the time of going to press), and all four use passive house components including triple-glazing and MVHR, and have high airtightness and very low fabric U-values.

As David Callachan explains: "We want to build to passive house to take fuel poverty out of the equation: that was the driver for us." (Octavia is one of a small, but growing, number of social landlords who are looking to passive house to help protect their tenants from fuel poverty: see 'Passive house goes large', in issue five of Passive House Plus)

Site, design and planning

Though Octavia does not welcome the necessity of having to build for the private market, there are some upsides, says David Callachan: "It does give us a mixed development, with dwellings built to identical high standards for everyone, regardless of occupancy — indeed some are literally identical."

The Sulgrave Gardens development, designed by architects Cartwright Pickard, is certainly pleasant to look at: partly because of its relatively small size and mix of different building types. And as Octavia hoped, it isn't obviously identifiable as a particular type of housing – either for a particular type of occupant, or following a particular construction philosophy.

The two three-storey terraces of houses are probably the most attractive, but all four blocks are lowish-rise (three-to-five storey) and clad in a warm browny-yellow brick, with balconies, louvred wooden shutters, and other features adding texture and interest. All homes are now occupied, including the private units, which sold readily.

Achieving Passive house

The designers faced numerous challenges alongside the goal of reaching passive house. The site was constrained, with the new footprint running right up to the surrounding buildings along some boundaries, and it is sandwiched between two conservation areas (of Victorian terraces), which led to various extra preconditions. Although the planners were very approachable and generally supportive of the passive house aims, they still made a lot of stipulations.

The project was also constrained financially: land prices in central London are so high that ▶

not a centimetre could be wasted; Octavia needed to squeeze in as many units as they possibly could.

The planners required brick cladding throughout, which added a lot of cost. As David Callachan put it: "It's the most expensive part of building that isn't doing anything except appearance. It's not needed structurally or thermally, but there was no choice."

Although the initial ambition was for all four blocks to be certified, in the end two of them (the mews houses, and the "corner" apartment block) could not practicably be brought to the passive house standard, mainly because of their shape, which involves complicated set-backs and overhangs, partly for aesthetic reasons, and partly to squeeze as much living space as possible within the planning constraints – resulting in a form factor of around four for the two non-certified blocks, deemed too high to make passive house practicable.

The mews houses also sit quite closely behind a four to five storey apartment block to the south, ous glazing for daylighting, and good-sized patio doors: again, posing a challenge to the fabric. As Chris Grubb explained: "We worked with manufacturer Internorm to improve the insulation in the frames and tune up the fixing method."

The designs avoided the too-ubiquitous floor to ceiling glazing, and other performance-impairing excesses, however, to Atelier Ten's relief: "The architects were very good; once they understood what the requirements of passive house were, we did manage to keep them in check!"

Refining these details to ensure passive house was met meant that design did not always manage to keep pace with the construction schedule, leading to some cost overruns, Octavia's David Callachan admitted. "Instead of the usual process of architect to engineer to site, the architect would draw something, it would go through PHPP and be shredded, go round again – it was cyclical. And then you'd come up with an agreement and find it wasn't buildable."

Some apparently quite minor aspects of the design

"We learned a huge amount. Would we re-invest that experience in another passive house project? Yes we would."

limiting winter solar gain, and again making passive house harder to achieve.

In the non-certified blocks the calculated heat demand has ended up at around 35-40 kWh/m^2/yr, as opposed to the 14 kWh/m^2/yr for the two passive house units. Even in the certified blocks, engineers Atelier Ten point out, over-shading from adjacent buildings on the dense urban site means "fabric and form have to work harder".

The team opted for a SIP system with additional insulation to get to the required U-values of around 0.1. At the contractor's preference, the taller (apartment) blocks have a concrete frame, with the SIPs wrapped around; for the houses, the SIPs form the structure.

As Chris Grubb of engineer Atelier Ten explains: "We were quite constrained on the options for construction systems, as not only did we need the high thermal performance, we wanted to minimise the thickness of the wall build-up, to give us the maximum useable space. On top of that, anything requiring large lorries or cranes was ruled out, as we would not have been able to get them on to the site.

"The walls are Kingspan panels with additional rigid foam insulation. Despite the brick cladding, at 450mm this was a thinner construction than a block/insulation/masonry cavity construction with the same U-value. Although the SIPs are more expensive as a capital cost, they go up very quickly so there are savings on the build cost."

In a tight urban site there is generally little flexibility about orientation – so the private yards of the townhouses are to the north, yet despite this unfavourable direction it was felt that £1m+ house buyers would expect gener-

led to significant holdups. For instance, the brick cladding had to be tied to the structure, which means the fixings penetrate the insulation. Chris Grubb explained: "We had to search for fixings that caused less thermal bridging than metal; some were eventually found using a less conductive composite."

The thresholds posed a similar challenge. "A conventional concrete block would have created a thermal bridge; modelling showed that timber would perform better, but there were questions about its longevity. In the end a Marmox block, made of XPS with reinforcing rods in the direction of the stress, was identified as a solution to this."

Services

Heating is by individual gas boilers, feeding small radiators and towel rails. The same boilers provide hot water (in combination with solar thermal in the houses). Chris Grubb explains the thinking behind this strategy: "We did look at heating via an electric element in the MVHR (a classic passive house solution), but because passive house certification sets a ceiling on the total primary energy, and because electricity generation and transmission are inefficient compared to burning the gas directly in a boiler, it works out that individual gas boilers use less primary energy for the same delivered heat."

As heat loads can be very low, especially in the shoulder seasons, Atelier Ten specified boilers that can be modulated down to around 3 kW, instead of the usual 6 or 7 kW. "We are running the heating at quite a low temperature – 40 degree flow and 20 degree return, for even heating," Chris Grubb added. The effectiveness of this was endorsed by one of the townhouse occupants, who observed: "We really notice when we're visiting friends in their old houses, how hot

they have to run their heating to compensate for the cold draughts – it's a real hot blast compared to our gentle background warmth".

Also very noticeable in these homes is how very quiet they are – despite their busy central location: you can see the buses going along the nearby Goldhawk road, but you can't hear them. The ventilation is also extremely quiet – not noticeable, despite the hushed interiors.

The main strategy to deal with potential overheating in summer is the addition of simple louvred wood shutters on the south-facing windows. These are manually operated, running on rails, and are very light and easy to move via an open window (as verified by this Passive House Plus reporter.)

The town houses facing the street are also equipped with roof lanterns, with frosted panes that light the stairwell, and double as vents to aid purge ventilation. The lanterns are visible as chimney-like structures on the roofline; one might have expected on a passive house that features like this would not be part of the thermal envelope — but here, they are.

Although the planners were keen on them, with the benefit of hindsight they may have been more trouble than they were worth. "They were really hard to get airtight," David Callachan recalled, "there was an awful lot of folding of airtight membranes which was very tricky, especially working at height over the stairwell." Atelier Tens Chris Grubb agreed: "Skylights might have been a bit easier," he conceded.

Getting the build consistently to passive house standards – while keeping to some semblance of the original schedule – was challenging for all concerned, as David Callachan admits.

"Everybody really has to buy in. As the client I was incredibly involved, I really had to be right in the centre of it, to push things along. We also had a full-time site manager plus a passive house specialist (and airtightness champion) but even then we struggled to get to the level we needed.

"It's very different from a conventional build – people had to understand that if something didn't quite join up you couldn't just hide it behind some plasterboard – the air tester would find it out!"

Handing over to occupants

As explained above, Octavia aimed for passive house as they wanted to drive down living expenses and provide decent, healthy homes to their tenants. The occupants are expected to fulfil their part of the bargain, however. The tenancy agreements and leases stipulate that occupants must keep the MVHR on at all times – if any mould or damp damage arises, the tenants will have to take responsibility for sorting it out.

"We've explained this to all the occupants; we also expect them to replace their own MVHR filters, understanding how small a cost it is compared to the heating fuel they are saving."

Contact with occupants has been quite intensive: "Before they even moved in they were made acutely aware that the homes were different. Then when they moved in they all had an individual session with passive house expert ▸

(opposite, top to bottom) Aluminium clad sections contrasts with the Weinerberger brick; sliding timber shutters combine form and function; (p31, clockwork from top) the new development and (inset) the scheme it replaced; Internorm Edition windows were used throughout, with the exception of 16 outward opening Nordan Ntech windows; roof lanterns proved problematic to make airtight; the Kingspan Tek SIPs structure going up.

Dominic Danner. They have all had handbooks and a DVD, a six week visit, and will have two more contacts over the year – so that makes six points of contact in their first year."

Post-occupancy research in other passive house buildings suggests this is by no means overkill: certainly, the occupants interviewed by Passive House Plus after four of the proposed six encounters seemed to have a reasonable, but not yet complete understanding of how their homes worked – not that this was a problem for them. "It's got to be the way to go," they believed.

What was learned – and would they do it again?
As with most first-time passive house builds, everyone involved worked extremely hard – and learned a lot.

All parties agreed that some of the delays might have been avoided if the requirements of passive house had been fully taken on board at an earlier stage in the process. Certainly Atelier Ten felt the process had taught them that: "We learned that you need to look at procurement and design differently, not go down the traditional route design stages A-F then go out to tender; you need the contractor involved early to look at the buildability."

Contractor Durkan agrees: "It's all about how we integrate as a team. The success of a build like this depends on the integration of architect, engineers and contractors; and on our integration with our supply chain," development director Daren Nathan explained.

"Appointing a passive house controller (Dominic Danner) was a really important part of the delivery. He was our own person in the design process, he acted as a link between design and construction."

"We also find that BIM enables all the consultants to work together from the start. It makes it another type of experience altogether, it is really valuable in the delivery of any contract."

Teasing out any extra costs attributable specifically to passive house from other additional costs in this complicated project is tricky. One of the costs was the loss of the profit on one private unit, as "the terrace at the front was originally seven units but the extra thickness of the walls meant that we had to reduce the number to six," David Callachan says.

Overall, as a very rough estimate, Octavia suggest that the initial assessment for extra costs to deliver passive house at Sulgrave Gardens was around half a million pounds on a £6 million ▶

contract – about 9%. "But the value of the contract went up, so we had to bite the bullet and pay more," Callachan says. "However the contractor also had to absorb some extra cost, as did the architect. Effectively we all had to invest extra, but we all recognised this was R&D – an investment for future projects."

And all parties are ready to go back for more. Next time around, they would have the benefit of a great deal more understanding of how to go about passive house. "This is something we can improve," David Callachan believes. "I am personally very keen to do another project, using the same team, the same people."

"Would we do it again? Yes, definitely", Callachan and architect Dalziel Cook agreed. Chris Grubb from Atelier Ten also felt this should be the first of many passive house builds for his firm: "We think passive house is a great methodology, and the fact that residents are enjoying comfortable, warm homes is a great testament to how it's working. I'd like to live in one myself."

This is echoed by Durkan's Daren Nathan. "We learned a huge amount. Would we re-invest that experience in another passive house project? Yes we would." Durkan have learned what they would look for in terms of the collaborating partnership, and the style of contract: "This was design and build, but we would probably revert to a more traditional type of contract, where the architect comes on site and is responsible for the QA."

However there is no question that Durkan believes they want to build passive house again: "Passive house definitely has a future as a product. There has been great feedback from the occupants: the environmental quality inside is extraordinary. Octavia have got an absolutely stunning scheme."

SELECTED PROJECT DETAILS
Client: Octavia
Architects: Cartwright Pickard
Service engineers (M&E) & environmental design consultants: Atelier Ten
Structural engineer: Campbell Reith Consulting Engineers
Contractor: Durkan
Landscape architects: Grontmij
Passive house certifiers: Peter Warm
Airtightness consultants: Gaia Aldas
SIPS Panels: Kingspan Potton
Insulation: Kingspan/ Knauf
Thermal breaks: Marmox
Sliding shutters: Contrasol
Brickwork: Wienerberger
Airtightness products: Tyvek/Ecological Building Systems
Waterproofing (groundslab): Visqueen
Waterproofing (roofs): Bauder
M&E: Hanover Electrical
Steelwork: Graywood Engineering
Windows: Internorm / Nordan
Heat recovery ventilation: Zehnder/Paul
Plasterboard: British Gypsum
Solar PV: Panasonic
Solar thermal: Heatrae Sadia
Gas boiler: Vaillant
Aluminium composite panels: Etalbond
Engineered timber flooring: Tilo
Ceramic tiles: Swedecor

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PROJECT OVERVIEW:

Development type: Mixed residential development of 30 units across four blocks: a three-storey terrace of six units (Block A), a four-storey maisonette of 12 units, a four to five-storey eight-unit apartment blocks, and a three-storey mews with four units.

Location: Sulgrave Gardens, London W6 7RA

Completion date: September 2013

Budget: £5.3m

Passive house certification: Blocks A: certified. Block B: certification pending. Blocks C&D: not certified.

Space heating demand (PHPP): Blocks A & B: 14k kWh/m²/yr. Blocks C&D: N/A

Heat load (PHPP): Block A: 13 W/m², Block B: 8.8 W/m², Blocks C&D: N/A

Primary Energy Demand (PHPP): Block A: 92 kWh/m²/y, Block B: 80 kWh/m²/yr, Blocks C&D: N/A

Environmental assessment method: Code for Sustainable Homes level four (all blocks)

Airtightness: Block A: 0.6, Block B: 0.6, Block C: 1.02 (all ACH at 50 pascals) Block D: 0.86 m³/hr/m² at 50 pascals

Energy performance certificate (EPC): All units achieve B ratings with figures from 87-90.

Thermal bridging: The design team designed and tested 2D and 3D thermal bridges across Block A and B using Therm. These details were then evaluated for buildability by the contractor and changes were tested before work commenced on site. Thermally broken windows and doors were used for all four blocks, with Marmox Thermoblocks at thresholds.

Ground floor: All blocks feature 240mm reinforced concrete slab; damp proof membrane, 200mm phenolic insulation, separating membrane, and 70mm screed. Block A has an engineered timber floor & ceramic tiles, U-value: 097. Blocks B, C & D have vinyl flooring and ceramic tiles. U-value: .092

Walls: Blocks A & D (timber frame): 102.5mm facing brickwork externally, followed inside by 50mm cavity, 90mm phenolic insulation, breather membrane, 142mm SIPs panel, airtightness layer, 25mm timber battened service zone 2x15mm plasterboard lining with skim finish. U-value: 0.103
Block B & C (concrete frame): 102.5mm facing brickwork externally, followed inside by 50mm cavity, 90mm phenolic insulation, breather membrane, 142mm SIPs panel, airtightness layer, 25mm timber battened service zone 2x15mm plasterboard lining with skim finish. U-value: 0.103
Blocks B, C & D have some areas of aluminium cladding, with a similar build-up behind. U-value: 0.097

Roof: Block A & D: 500x250mm fibre cement slate externally, followed underneath by 25mm timber battens, 25mm timber counter battens, breather membrane, 80mm phenolic insulation, airtightness layer, 25mm timber battened service zone, 2x15mm plasterboard lining with skim finish: U-value: 0.103
Block B & C (concrete roof): 50mm paving on spacers, followed underneath by geotextile membrane, 360mm phenolic insulation, fully bonded waterproof membrane, 240mm reinforced concrete slab, airtightness layer lapping onto underside of concrete slab, services zone (varies), 1x15mm plasterboard lining with skim finish or suspended, ceiling in communal lobbies. U-value: 0.1
Block B (timber joisted roof): 50mm paving on spacers, geotextile membrane, 360mm phenolic insulation, fully bonded waterproof membrane, 18mm WBP board, 245mm timber engineered I-joists filled with mineral wool insulation. 9mm OSB board, airtightness layer, services zone (varies), 1x15mm plasterboard lining with skim finish or suspended ceiling in communal lobbies. U-value: 0.093

Windows: All blocks feature Internorm Edition triple-glazed, argon-filled composite windows with a low e coating, ISO spacer and silicon superspacer. Overall U-value: 0.74
Blocks B & C respectively have seven and nine outward-opening Nordan NTech timber aluclad triple-glazed windows. Overall U-value: 0.9

Ventilation: Block A: Paul Focus 200 MVHR system, Passive House Institute certified. 91% heat exchange efficiency.
Blocks B, C & D: Zehnder ComfoAir 200 MVHR system, Passive House Institute certified. 92% heat exchange efficiency.

Heating: MVHR with supplementary Vaillant gas boilers, including combination boilers in blocks B & C, and system boilers with solar thermal in blocks A & D.
91 sqm of Heatrae Sadia solar thermal panels were installed across the site, with an approximate annual output of 34,650 kW, roughly 30-35% of domestic hot water demand in blocks A&D.

Electricity: Across the site, there are 137 Panasonic HIT PV panels, covering an area of 192 sqm with an approximate peak load of 25.3 kW across all blocks.

Green materials: All timber used was purchased in line with the UK Sustainable Timber Procurement Policy.

Passive office cuts bills by £25k & absenteeism by 13%

Anyone who thinks the passive house standard isn't relevant to non-domestic buildings is missing a trick. One certified passive office in Leicester reveals the significant benefits companies can yield in terms of saving energy, increasing productivity and improving the bottom line.

Words: Lenny Antonelli

Passive house architects and contractors sometimes joke they spend all their time constructing low energy buildings — while they go on living and working in cold, damp, leaky structures.

One big contractor, Interserve, hadn't built to the passive house standard before — but when it came time for its Leicester base to move homes, it realised the time was right to build a more comfortable office space.

The branch had been working from an old dormitory block originally built for National Service personnel. "It was a horribly inefficient building," says John Walkerdine, Interserve's business development manager.

The rent was cheap, but staff needed to run a big gas boiler around-the-clock just to provide hot water, so the heating bill was a whopping £23,000 a year. It was time to move.

Interserve started making plans to build a new Leicester office. Raynsway Properties agreed to develop the new building, which Interserve would then rent. The contractor's rent was going to rise, but it realised that if its new home used less energy, its heating and electrical bills would be lower, and this would help offset the increase in rent.

Interserve originally planned to construct the building to an ambitious Breeam level. Then leading passive house architect Jonathan Hines of Architype came to speak at the company's annual conference.

"All of a sudden it opened our eyes," John Walkerdine says. He had heard of homes built to the passive house standard before, but not offices. Interserve was sold on a design philosophy that would focus entirely on the building fabric — and associated

Photos: Harry Strong/Interserve

energy savings. And because Interserve would naturally act as contractor, the project could showcase the firm's ability to construct an ultra low energy, airtight commercial building.

Interserve had already appointed Crouch Perry Wilkes as the M&E consultant, and as the company had in-house passive house designers CPW also took on the job of passive house consultant. The design team also included architects CPMG and structural engineers BWB Consulting.

The original design had the main facades facing east and west to maximise the building's prominence to the road, but with the new passive house goal in mind, the team beefed up the insulation and airtightness spec and turned the building so the main glazed facade would face south.

One of CPW's main goals, which demanded laborious calculations, was working out how to maximise natural light inside — through the smart placement of glazed facades — while making sure the building's space heating demand stayed within passive house limits.

The design complied with passive house overheating criteria, but with a lot of internal gains from staff and electrics, it failed to meet CIBSE's overheating guidelines. At this stage the glazing design had been finalised, and met both daylighting and space heating demands. So the team decided that some form of shading was needed to combat potential overheating.

A fixed shading system would have been cheaper, says CPW's Matthew Wrate, but wouldn't be as flexible, and wouldn't allow the building to warm up on sunny days when unoccupied. So Interserve instead plumped for a motorised Levelux external blind system, which has five settings, each offering a different degree of solar gain.

The blinds act as the first port of call for the heating setup. If the building management system senses that the temperature inside has dropped below 20C, an irradiance sensor checks how sunny it is outside, and if it's bright enough, opens the blinds to let the sun in.

If there's not enough sunshine, or solar gain doesn't boost the temperature above 20C, the building's active systems kick in. First, the BMS starts to bring fresh air for the heat recovery ventilation system through an underground Rehau Awadukt Thermo ground-air heat exchanger — also known as an "earth tube" system — before delivering it inside.

The Rehau system consists of 250 metres of pipework installed about two metres below the ground. Because the temperature down here remains relatively stable throughout the year, drawing incoming fresh air through the earth tubes preheats it in winter but cools it down in summer. On very hot or cold days this can change the temperature of incoming air by 6C or more, before it even enters the building. This also helps to smooth out internal temperatures, given that the building's structure lacks thermal mass.

Meanwhile, the heat recovery ventilation system also extracts air from the building's server room, cooling the room down. This allowed the team to avoid putting in a separate fan for cooling the servers here.

If pulling air through the earth tubes on cold days doesn't get the temperature up to 20C, two 16 kW Daikin air-to-water heat pumps kick in (if the building is unoccupied, the earth tube stage is bypassed and BMS jumps straight from passive solar heating to the heat pumps).

The Daikin units supply space heating through radiators — one serves the entire open-plan office floor, while others serving individual meeting rooms. Matthew Wrate says this made more sense than delivering heat through the ventilation system because the building is unoccupied about two thirds of the time, and it would be inefficient to run the whole MVHR system to heat an unoccupied building.

The building is constructed with a Durisol insulated concrete formwork system. The insulating blocks are comprised of over 90% recycled softwood — by-products of the timber industry — that's bound with portland cement. The blocks are manufactured in the UK using harvested rainwater. Durisol say the product is lightweight and designed to be easily cut, nailed and screwed ▶

(top) a Rehau earth tube system was installed beside the building, to assist with heating and cooling when needed; the building's pitched roof was insulated with 340mm of Earthwool FactoryClad rolls, giving a U-value of 0.14.

with a carpenter's normal tools.

On site, the blocks are dry-stacked, and concrete is then poured into the vertical cavity to create structural columns. To boost the U-value of the walls to passive house levels, Interserve installed an extra 50mm of Celotex PIR insulation on the building externally.

The building has two roof sections: a main pitched roof that's insulated with 340mm of mineral wool, and a small flat plywood roof with 160mm of Celotex. The thermal bridging surrounding the guttering was overcome by an extra 100mm of Celotex insulation internally around eaves level to combat the fixing bolts that hold the gutter in place. Meanwhile the trench fill foundation is wrapped with 100mm of the same insulation.

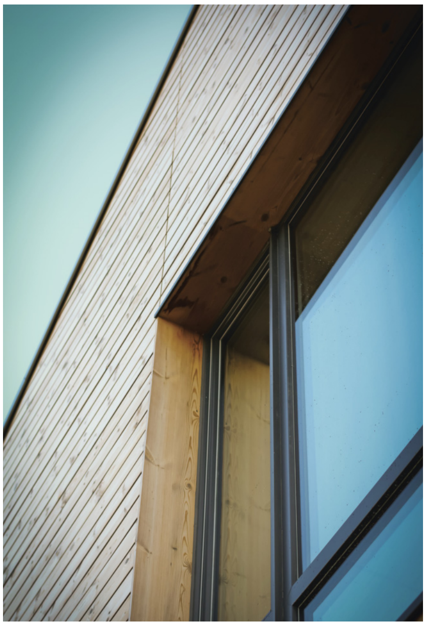
Rehau also supplied windows and doors for the whole building — triple-glazed, krypton-filled Geneo units which are passive house certified to achieve a U-value of 0.8. The windows were manufactured using Rehau's recyclable Rau-Fipro fibre composite material, which the company says is similar to fibre composites used in aircraft construction and Formula 1 cars.

When it came to the airtightness test, just before staff moved in, the building scored 0.44 air changes per hour. "We were brave or stupid and we didn't have an airtightness test until the day before handover," John says.

Away from the building fabric, CPW also helped Interserve to save energy by advising a change to the company's printing strategy. Rather than each employee having his or her own printer as before, big centralised printers now sit in the server room.

The building is topped with an 18kW solar photovoltaic array that covers more than 120 square metres of the roof.

Interserve had bought the panels in China with the intention of selling them in the UK. But then the price of PV in the UK dropped, and putting them on the market proved less attractive. So installing some of the panels on its own roof made sense, and enabled the building to be certified as energy positive on its Energy Performance Certificate with a score of -2 (without the PV panels, the figure was 18). ▸



It also means that the building now earns Interserve £1,430 a year for energy production — as opposed to the £23,000 it was paying for heat before. “Financially we are £25,000 a year better off on the energy costs,” John says.

He adds there has been a 13% drop in absenteeism due to reduced sick days compared to their old offices, which he attributes to improved indoor air quality. The company’s previous Leicester office relied on opening windows for ventilation, and the staff would shut the windows when the weather turned cold and leave them shut all winter, meaning no ventilation other than infiltration. With the building’s MVHR delivering frequent air changes, John says that infections are less likely to spread.

The building management system is now closely monitoring every facet of the building: internal CO_2 levels, water consumption, energy use in every part of the building, ventilation and more.

Interserve has since used its new passive house expertise to construct two passive schools, and is developing a standard passive house design for commercial offices. The goal is to make passive house competitive on price with standard construction in the commercial sector.

Walkerdine says the company’s Leicester passive office ended up coming in at £180 per square foot, but that this could have been £165 if certain mistakes weren’t made.

But now, he says Interserve can deliver a passive house office block, built with externally insulated masonry, for £145 per square foot. This, he says, could be the difference between a developer thinking passive house is nice but expensive, and biting the bullet and aiming for the ultra low energy standard.

And he adds: “At the end of the day we’ve got a brand new super office we’re delighted with.”

SELECTED PROJECT DETAILS
Client: Raynsway Properties
Main contractor/tenant: Interserve
Passive house/M&E consultant: Crouch Perry Wilkes
Architect: CPMG
Engineer: BWB Consulting
MVHR: Pichler
Heat pumps: Daikin, via Pure Air Conditioning Ltd
Solar PV panels: Jinco
Windows & earth tubes: Rehau
Mineral wool insulation: Knauf
PIR insulation: Celotex
ICF system: Durisol
Solar controlled blinds: Levolux
Airtightness products: Arbo/Ecological Building Systems

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(clockwise from below) the walls are clad with Thermowood; windows are passive house certified Rehau units; an 18kW PV array has helped ensure this passive building is energy positive; (p37, top) careful design ensured the building’s steel trussed roof – which is expressed in the building’s architecture – did not penetrate the building’s thermal envelope, with joist ends housed in AAC blocks; (bottom) the building is ventilated by a Pichler MVHR system with rigid ductwork.

PROJECT OVERVIEW:

Building type: Detached office building on edge of city business park

Location: Syston, Leicester, England

Completion date: September 2011

Construction Cost: £1,780/sqm

Space heating demand (PHPP): 13kWh/m²/yr

Heat load (PHPP): 11 W/m²

Primary energy demand (PHPP): 98/kWh/m²/yr

Airtightness (at 50 Pascals): 0.44 ACH

Energy bills: In 2012, the building achieved an energy credit of £1,430 due to the combination of low energy consumption and photovoltaic micro generation.

Ground floor: Precast concrete floor with Celotex insulation – 170mm in trench fill foundations insulated with 100mm Celotex insulation. U-value: 0.21

Walls: Walls consisting of wet plaster + tapes/sealants at junctions for airtight layer to Durisol ICF blocks, externally overclad with 50mm Celotex insulation and Thermowood cladding. U-value: 0.14

Roof: Pitched roof insulated with 340mm Earthwool FactoryClad rolls, U-value: 0.14 Flat roof with 160mm of Celotex PIR insulation. U-value: 0.136

Windows: Triple-glazed passive house certified windows manufactured by Rehau using differing coloured PVC sections on inside and outside surfaces. U-value: 0.8

Heating: 2 x 16kW Daikin air-to-water heat pumps serving radiators for space heating, and heating coil in the Pichler mechanical heat recovery ventilation system. Hot water supplied by point-of-use electric heaters.

Ventilation: Pichler LG4000 passive house certified heat recovery ventilation system. Heat recovery efficiency of 84% (PHI). Incoming air can also be drawn through Rehau Ecoair ground-air heat exchangers/earth tubes to provide natural pre-heating or pre-cooling.

Electricity: 96 x 190 watt PV panels on the south facing roof 122.557M2 or 18240 watts from Jinco with SMA controls.

Green materials: Recycled aggregates/hardcore, Thermowood cladding boards & recycled steel used in reinforcement

Three passive house dwellings in the East Midlands are part of a new multi-million pound regeneration programme by social housing provider East Midlands Housing Association (recently rebranded as emh homes). The first phase of the scheme, nine houses at Hart Lea in Sandiacre, was completed in October 2013.

Following the advice we gave at Encraft, the design team decided to adopt a passive house inspired, fabric first approach on the development of nine new houses. But it was Lindum, the main contractor, who decided to aim for full passive house certification.

Lindum would have effectively met the standard anyway in delivering the fabric first approach outlined in the tender. But as it was not an explicit requirement from emh, passive house certification was only made possible through Lindum's commitment to achieving the standard.

Early analysis carried out in PHPP showed that certification would be achievable with no further enhancements to the tender specification, at least on plots with favourable orientation.

To be sure of success, Encraft worked with Lindum throughout design and construction to develop the detailed designs in line with passive house criteria.

Our initial involvement with the project came through Ridge and Partners in Leicester who were working on behalf of emh homes as project managers. At the time the scheme was being designed in the traditional way, by a design team familiar with emh's previous schemes and standard design brief. However with additional requirements to meet level four

EAST MIDLANDS SCHEME

opt for passive regeneration

Photos: Matt Short Photography

One third of the units at a new social housing development in the East Midlands have met the passive house standard— but the entire project was inspired by fabric first, low energy design.

Words: Helen Brown, head of building physics, Encraft

of the Code for Sustainable Homes (CSH) and Lifetime Homes, Encraft took the lead to evaluate how the scheme could meet these targets.

Having recent experience of building to varying code levels, emh was already aware of the potential pitfalls of achieving compliance with the code's energy requirements. Poor integration of low carbon technologies, high maintenance issues, dwellings not performing as expected and homes having higher bills than predicted — these were all problems that emh is keen to avoid on their new build schemes.

Based on past experience, it was clear that the favoured approach would be to adopt a fabric first build specification that would enable the scheme to achieve the required energy performance without the need for any bolt-on renewables, while also delivering the lowest predicted fuel bills for residents and the lowest whole life costs for emh.

A passive house inspired fabric first approach was pitched against more commonly adopted high-tech approaches, including ground and air source heat pumps, and bolt-on renewables such as solar PV and solar thermal. The whole life costs and benefits of each option were evaluated to estimate lifetime performance, which should always be a key factor for social housing providers who have a long term vested interest in their building stock.

This evaluation presented the fabric first approach in a complimentary light, and helped to justify extra capital expenditure. While emh was sold on the idea of a fabric first approach they feared that full passive house certification for the development could potentially overinflate build costs. Furthermore, the project had already been submitted for planning and there was a need to be onsite within a specific timeframe which meant that the scheme was already constrained in terms of site layout and building design.

Encraft proposed a specification for the build which would enable passive house standards to be achieved for the plots with the best orientation and building form factor. Initial analysis in PHPP focussed on plots that were expected to perform best. By aligning the passive house design criteria with the best-performing plots we were able to ensure the cost-effectiveness of the scheme — especially as there were bungalows on which it would have been challenging and costly to achieve certification.

We arrived at a build specification which could be applied across the entire site, enabling certification of three plots while ensuring that the remaining six dwellings would be built to the same high standards. Using this tactic, all dwellings on the site would end up as close to the passive house standard as practically possible, while keeping within budget.

In the end all plots were modelled in PHPP with the best performing only just achieving the passive house heating load target of 10 W/m^2 and the worst (a bungalow) around 3W/m^2 worse than this. It would not have been possible to certify on the basis of the space heating demand target, which ranged from 19 kWh/m^2/yr upwards.

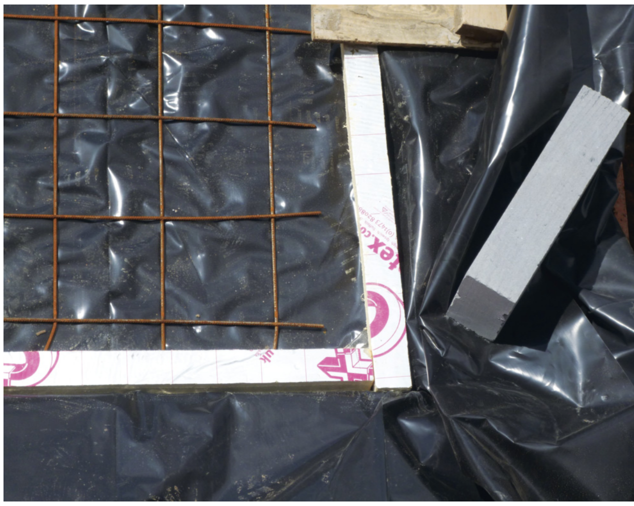
The build specification, on which contractors were invited to tender, included: a contractual requirement to meet the passive house air leakage limit of 0.6ACH at 50Pa; limiting U-values to 0.1 in the walls, roof and floor; Sheerframe triple-glazed windows and doors with an installed average U-value no worse than 0.85 and prescribed G-factor of 0.6; enhanced construction detailing to achieve a Sap Y-value no worse than 0.05; Glow-worm condensing gas boilers for heating and hot water; and mechanical ventilation with heat recovery provided by the Paul Focus 200 from Green Building Store. With this specification CSH level four is attained without the need for any renewable energy.

Although contractors were given a fairly detailed performance specification for the build, they were invited to tender on the basis of a design and build contract. This gave them the freedom to propose their preferred method of construction, while ensuring the lowest risk for emh in terms of their contractual obligations and design responsibility.

The contract was awarded to Lindum Construction in November 2012, who priced competitively at just under £1,400 per sqm for the total cost of the build and proposed to use the Val-U-Therm off-site build system which promised to deliver the required thermal protection, quality control and airtightness performance standards. ▶

(clockwise from right) The Val-U-Therm timber frame walls were supplemented with a Glidevale membrane, service void and Kingspan TW55 PIR insulation; the ground floors are insulated with 200mm of Celotex insulation, and Thermalite AAC blocks were also used in the ground floor details; cooker extract fans recirculate indoor air after passing it through a grease filter, thereby not piercing the airtight layer; the houses feature Airflow DV72 mechanical ventilation heat recovery systems with inline battery heaters and radial duct system distribution box.

(p45, l-r) Lindum MD Simon Gregory, emh homes CEO Chan Kataria, Cllr Carol Hart & Encraft's Helen Brown launch the scheme.



The Val-U-Therm wall system exceeded the thermal protection requirements with a U-value of 0.09. This enabled some flexibility in the design for meeting the passive house criteria. Similarly, a switch from the Sheerframe windows and doors proposed in the tender to the passive house certified range from Munster Joinery added to this performance buffer because the Munster option is slightly better performing in the PHPP (as well as being cheaper).

Lindum decided not to use the complete Val-U-Therm system, which can include both ground floor and roof elements in one integrated build system. The basis of this decision was cost, as implementing a traditional suspended concrete beam floor and attic truss roof looked likely to be the more cost-effective option at the estimating stage. However, connecting the Val-U-Therm walls to the more traditional floor and roof elements proved to be quite time consuming, both in the design detailing and subsequent implementation onsite, particularly in regards to airtightness and thermal bridge details. Time and effort would certainly have been saved if the complete Val-U-Therm system had been used. It would be interesting to evaluate how much of an impact on build costs this would have had.

In general construction details were developed in a collaborative way with lead designers Geoff Carter Architects taking specialist design input from Encraft, particularly in regards to airtightness and thermal bridge details. A clear strategy for airtightness was defined to incorporate a single air barrier, primarily consisting of Glidevale vapour control membranes on the warm side of all major elements, connected with appropriate tapes at junctions and into the window reveals.

Although the Val-U-Therm wall panel has an OSB layer there was some nervousness around relying on this as the main air barrier. A service void was incorporated into the design to ensure that the air barrier would be fully protected, both during construction and beyond. And the air barrier wraps around adjoining plots, such that the party walls between dwellings are not airtight. This approach saved on time and materials and negated the need for a service void in the party wall.

Airtightness details were generally much easier to draw on paper than they were to realise on site. Sequencing notes were written to complement the critical construction details. These were found to be a useful aid to improving buildability. Lindum's site manager acted very successfully as the scheme's airtightness champion, whose role was to make sure that airtightness details were understood and adhered to, take ownership of quality control, check that the correct materials were being used (such as refusing to use duct tape in place of the specified air barrier tape) and communicate the importance of airtightness to everyone on site.

All airtightness details were implemented by the Lindum site team so that they could take full ownership of this aspect of the build rather than having to rely on subcontractors. Regular site visits from Encraft ensured quality standards were met. We provided feedback on areas that could be improved and reassurance when things were done well. The window detail posed a particular challenge and it then took a considerable amount of time to seal the frame into the reveal for airtightness following Munster's installation, which only fixed the windows into position.

Airtightness testing was carried out at interim stages, when the air barrier was still exposed, so that we could look for leaks and make improvements as necessary. Observed weak points were mainly around the window and door reveals. The windows – which are passive house certified – were airtight as a window unit, but there was leakage from the uncertified doors, the weak point being where the doors seal to the door frame.

Final air testing was carried out by UK Air Testing and all plots managed to achieve passive house standards with results across the site ranging from 0.46 to 0.58ACH at 50Pa and the passive house certified plots tested at 0.54ACH at 50Pa.

Heating and ventilation system designs were developed by the installers, RJ Wilson with design input from Encraft to ensure passive house compliance. One area that Lindum and emh were able to save money, against the original tender price was in the MVHR system. Airflow's Duplexvent DV72 was installed in preference to the Paul Focus 200. The DV72 has efficiency in the heat exchanger of 91% according to SAP Appendix Q, which is equivalent to that of the Paul unit. But because this particular Airflow unit is not passive house certified there was a 12% penalty applied to the efficiency in the PHPP calculation. Even with this hindrance it was possible to meet the passive house criteria for building certification, if only on the south ▶

facing plots.

Furthermore, high system efficiency was ensured by positioning the central heat exchange unit on an external wall, thus allowing for the shortest possible intake and exhaust duct routes. The length of these ducts, which transport cold air through the thermal envelope, must be kept to a minimum to prevent unwanted heat exchange between the duct and the internal environment.

The MVHR units were installed in a plant cupboard which also housed the Glow-worm gas boiler, located on the ground floor; usually next to the kitchen and accessed via an external door (no internal access was provided). In this way emh will be able to easily access the plant for servicing and maintenance. Ease of access to the plant cupboard was a critical consideration because emh will need to visit at least twice per year to change filters on the MVHR units, on top of the annual boiler service and gas safety checks.

The plant cupboard also housed the electric PCT frost protection, as well as an in-line supply-air electric duct heater and Airflow's radial duct system (Airflex Pro) distribution box. The main controls for the MVHR system are also inside the plant cupboard, out of sight and out of reach from the building occupants. The MVHR system has been set to run continuously at a standard ventilation rate and no boost control has been provided, so residents do not really interact with the ventilation system at all.

The only controls which residents were provided with in the home were for space heating and hot water. This included a standard programmable time-clock as well as two room thermostats, one to control the space heating delivered by the gas boiler (provided by two towel heaters in the bathroom and downstairs WC) and one to control the electric duct heater.

Encraft took great care to write an easy-to-read home user guide which focussed specifically on the passive house aspects of the scheme, introducing the concepts of passive design to residents and helping them to understand how best to use the home and the technologies installed.

Great importance was placed on the functional aspects of the MVHR system, so that even while direct control of this system was not put in the hands of residents, they should still be able to understand how it works, why it is important, and be able to troubleshoot air quality problems and seek further advice or remedial work if it's needed. Further guidance was given on the operation of the heating controls and also what to do during summer to mitigate the risk of overheating.

This passive house specific home user guide was incorporated into the larger home user pack provided by Lindum in order to comply with CSH requirements. But it was the passive house specific guide which emh used predominantly in their initial discussions with residents and their intention is to use the guide repeatedly as a reference in future to deal with user problems or concerns when they arise.

Overall, Encraft was pleased to use our passive house expertise to enable certification of this landmark residential project for emh homes. Going forward, it would be great if this project could provide a stimulus for the wider uptake of the passive house standard in the East Midlands region.

SELECTED PROJECT DETAILS
Client: emh homes
Architect: Geoff Carter Architects
Developer: Lindum Construction
Passive house consultant: Encraft Ltd
Structural consultant: BSP Consulting
Quantity surveyor & project manager: Ridge and Partners
M & E contractor: RJ Wilson
Airtightness tester/consultant: UK Air Testing
Build system supplier: Val-U-Therm
Phenolic insulation: Kingspan
Mineral wool insulation: Superglass, via Total Insulation Solutions
Floor insulation: Celotex
Airtightness products: Glidevale
AAC Blocks: Thermalite
Windows and doors: Munster Joinery
Mechanical ventilation supplier: Airflow
Condensing boilers: Glow-worm

PROJECT OVERVIEW:

Building type: A 236 sq m terraced passive house new build. The certified building consists of three domestic dwellings and was built using a timber frame construction. Six other dwellings were built on the site – four semi-detached houses and two bungalows. All were built to the same specification but only the terraced row of three were certified due to its favourable orientation and form factor.

Location: Sandiacre, Leicestershire, UK

Completion date: November, 2013

Budget: £1m or £1,400 per square metre approx

Passive house certification: Three-dwelling terrace certified by the BRE

Space heating demand (PHPP): 19 kWh/m²yr

Heat load (PHPP): 10 W/m²

Primary energy demand (PHPP): 111 kWh/m²yr

Environmental assessment method: Code for Sustainable Homes – level 4

Airtightness (at 50 Pascals): 0.54 ACH

Energy performance certificate (EPC): B (85)

Thermal bridging: Heat Loss from thermal bridges reduced using a mixture of Advanced Construction Details and EST Enhanced Construction Details. Extra Kingspan TW55 low-e coated insulation added around the perimeter of the roof to reduce thermal bridges. Thermalite low density concrete blocks used in ground floor details with phenolic foam insulation in window reveals. Calculated Y-value using ACDs and ECDs of 0.045 W/m²K.

Ground floor: suspended concrete beam floor. 150mm concrete slab, 200mm PIR/PUR insulation, 75mm screed. U-Value: 0.106 W/m²K

Walls: ValUTherm timber frame wall. 15mm Knauf Wallboard fitted to Val-U-Therm panel system including 35mm unventilated battened cavity facing 25mm Kingspan TW55 low-e coated insulation, Glidevale Protect VC foil vapour control layer & either Protect VC foil tapes at window reveals or Glidevale Butyl tapes where nails penetrated the membrane, including 9mm OSB sheathing, 235mm injected insulated polymer derived from renewable vegetable oil with timber frame fraction 0.1, 9mm OSB sheathing, Protect TF200 Thermo, 60mm ventilated cavity, 103mm brick outer leaf. U-Value 0.090 W/m²K

Roof: timber truss roof. 150mm mineral wool with timber fraction .063, covered with 350mm Superglass mineral wool. The air barrier was a polythene membrane installed on the warm side of the insulation (at ceiling level) with a 25mm service void below to accommodate all electrical wiring etc. U-Value 0.098 W/m²K

Windows: Munster Joinery Passiv Future uPVC frames with Saint Gobain triple-glazing. 4-20-4-20-4mm with 90% argon cavity fill and low-e coating internal and central panes. U-value: 0.78

Heating system: Glow Worm Ultracom 12sxi 89.5% efficient condensing gas boiler, supplying two towel radiators and domestic hot water cylinder.

Ventilation: Airflow DV72 MVHR system (certified heat exchange efficiency of 91% according to SAP Appendix Q) with inline battery heater and Airflex Pro distribution box.

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Stunning Meath home

defies passive house stereotypes

A simple building form, few junctions and minimal surface area are some of the cornerstones of passive house design — but as this spectacular certified passive house in Co Meath proves, rules are made to be broken.

Words: John Hearne

Photos: Donal Murphy Photography/Peter Legge Associates/Archie O'Donnell

Architects Peter Legge Associates' new build in Meath takes you as far from stereotypical passive as you're going to get. It's beautifully designed, sleek and structurally complex, with a myriad of junctions and a wide variety of building materials.

The house demonstrates just what's possible when you have a client who assembles a team of highly experienced, highly motivated construction professionals determined to get something special over the line.

Architect Patrick Lloyd explains that this was a house where design and thermal performance got equal billing. "Our approach was that passive house was hugely important, but that there was no reason why good architecture couldn't go hand in hand with that."

Though there aren't any dramatic vistas, the architects still wanted to ensure all internal spaces had good views out to the green countryside.

The client did not seek a passive spec at the outset; while performance was an obvious consideration, so too were aesthetics and function. It was only as the design began to evolve that the possibility of going for the passive house standard began to emerge. Though the architects had not built a passive house before, principles of good orientation and passive solar design were already firmly ingrained in the practice.

"The passive aspect did not overly influence the design of the building," says Lloyd, "because we were going to place a large expanse of glass to the south in any case. We were going to place the small windows to the north. The actual form of the house wasn't necessarily driven by passive considerations because they were part of our approach anyway."

Passive house specialists Integrated Energy were brought in as consultants, to assist in technical detailing and the certification process.

"The architect didn't like the notion of designing the house on a spreadsheet," says the company's Archie O'Donnell. "On the one hand you have the aesthetics, on the other you have the thermals and often there's a conflict between the two, but the architect managed that conflict quite skilfully."

The designer's impulse to create great spaces, flushed with winter sunlight, segued perfectly with the passive need to collect free solar gains. The designer's desire to use space efficiently complimented the passive requirement for an appropriate floor to envelope ratio.

As O'Donnell points out however, the geometry of the building is not typical. "It would have a lot more surface area and a lot more junctions than an ideal passive house."

As in any passive house project, good design principles are just the beginning. In order to deliver a passive performance, getting the airtightness and thermal bridging strategy right is crucial. And in a house which features a range of complex junctions, the devil is in the details.

"The main reason this is passive is because of the time that was spent on it," says O'Donnell. The technical details for the glazed screen alone ran to twelve pages.

a higher spec. "At all stages of the design," says O'Donnell, "the building was precariously balanced on that line between certified and not certified."

It was such a marginal call that O'Donnell, rather than simply plugging in weather data from one of the default Irish sites, actually commissioned architect John Morehead to provide a weather file specific to the site. This file was then slotted into the passive house software and allowed the team to specify a glazing strategy specific to the site's topology and grid location.

Ultimately, the long man hours that went into designing away the thermal bridges paid off. The annual heating demand met passive standards without having to deviate from first preference components or certification.

"Making the contractor aware that certification was a condition of contract focused the minds of everyone onsite."

He explains that frequently on passive projects, the drafting of technical details is outsourced by the designer, but in this project, Integrated Energy worked on the airtightness and cold bridging details and these were then incorporated back into the architect's drawings.

It can be a painstaking process. "There is no short cut unfortunately," says O'Donnell. "There is no easy way to do it. You take each detail and pore over it and keep chipping away at it until you've eliminated the thermal bridges."

This is a challenge on many passive projects. In one of this complexity, it was doubly so. O'Donnell devised a budget for how much heat could be lost through thermal bridging without endangering certification. At one point that budget threatened to push the building's heating demand above the 15 kWh/m^2/yr passive house target. As a result, the design team's preferred glazing strategy came back on the table and was in danger of being torpedoed to make way for a higher spec.

Aiming not just for passive performance, but full certification, helped to keep everyone sharp on site. "There was a debate at one stage in construction," says Patrick Lloyd, "as to whether we would actually go for certification. We knew we were going to reach the performance levels anyway, but actually choosing certification and making the contractor aware that certification was a condition of contract focused the minds of everyone onsite. Everyone pulled together after that."

The primary construction method is concrete block-on-the-flat with external insulation. This was the client's preferred form of construction. Kevin Fay, who oversaw the project for the contractor, GEM Construction, agrees that this was a complex job.

"There isn't a straight corner in the building," says Fay. "That in itself provides its own challenges." He too singles out the various junctions between structural steel, blockwork, timber work and ▶

While passive house design tends toward generous south facing glazing and open plan layout, this project truly pushes the boat out. (p51, clockwise from top left) With the Reynaers triple-glazed sliders awaiting installation, the cantilevered structure seems to defy gravity; the first of two courses of Quinn Lite blocks installed to minimise cold bridging; the Brunner Kamin Kessel 62/76 stove; the airtight layer starts to form before wet plastering.

glazing as particularly challenging when it came to airtightness. GEM appointed an airtightness champion on site, whose job it was to ensure that all subcontractors understood that this was a passive house, with a passive house's stringent airtightness targets.

The house features a large 8m by 4m cantilever in one corner, held in place without visible structure. "That was related to the design brief," Patrick Lloyd explains, "the requirement to open up the rear facade to the countryside." The architect worked closely with structural engineers Casey O'Rourke Associates and Integrated Energy to ensure the integrity of that structure on the one hand, and to minimise its air leakage and cold bridging risks on the other.

Archie O'Donnell points out that the U-value goes far from passive spec at the frameless glass corner, which required a degree of ingenuity to resolve. A dedicated heating circuit was included in the underfloor heating – triggered by a temperature sensor where the screed meets the corner glass support – to compensate for the heat loss at this point.

Architectural features such as this also required an especially vigilant approach to workmanship. "We had our own Wincon machine on site," says Kevin Fay of GEM, "and that was invaluable." The machine – a stripped down blower door unit from Pro Clima for checking airtightness as a build progresses – was deployed frequently during the build to establish where weaknesses in the airtight envelope lay, and these were then corrected as the construction team progressed.

Fay had given a presentation on Part L and building control at the Better Building Conference in Dublin in 2012, where he described a blueprint for the practical steps needed to deliver

a low energy building. "This project was an opportunity for us to put those principals into practice," says Fay, adding that the attention to detail needed for airtight buildings such as passive houses requires meticulous and continual supervision on site. "If you get to first fix stage and you're hitting an airtightness of 3 ACH it's too late," he says, pointing out the need for a zero tolerance approach to workmanship that might inadvertently compromise the airtight layer. "Our site managers inspected workmanship before, during and after each trade to ensure continuity was achieved between trades and no damage was done to the building envelope with regard to insulation and airtightness." Both Patrick Lloyd and Archie O'Donnell are keen to pay tribute to GEM, and to Baker & Co Ltd – who supplied and fitted airtightness and roof insulation products – for their work on meeting the exacting passive house airtightness standard.

O'Donnell also notes the increasing professionalisation of the building trade in the post-boom years. On passive house sites in particular, it's more and more common to see contractors with engineering or passive design qualifications.

Patrick Lloyd adds: "The standard of workmanship that was required in relation to airtightness on this build was incredible. We spent a significant amount of time going through the building with a fine toothcomb making sure there were no leaks." The final blower door test registered an air change rate of 0.6 ACH, right on the passive target.

Harmon Vinduer supplied and installed windows and doors for the job, and designed interface details to ensure that the Psi values were compatible with the passive house requirements. Harmon installed Protec frames here, but have subsequently switched to Danish low energy ▶

window giant Velfac, by becoming the certified Velfac partner for Ireland.

One of the house's most impressive features is the triple-glazed sliding door system by Reynaers Aluminium, which effectively allows the entire hall area to open up to the outside. Though not a certified component, thanks in part to careful technical detailing, the system exceeded expectations during the blower door tests.

The building's primary heat source is a Brunner wood burning stove, supplied and commissioned by Eco Wood Burning Stoves. The stove is managed by a Brunner BHZ heat management system, which takes energy from the fireplace and sends it to a 1000 litre buffer tank. The Brunner system controls the burning of the stove based on temperature readings, to avoid wasting fuel, and also controls the house's array of Thermomax vacuum tube solar collectors.

"When the solar panels are producing higher output on a hot day the controller sends the heat to the top of the tank," says Kieran Brennan of Eco Wood Burning Stoves. "It prioritises hot water – which comes from the top of the tank, and sends lower temperature heat to the middle or bottom of the tank, for space heating and over capacity – so that the tank is picking up a preheat whenever available."

Outside, the house combines render and timber cladding, with 100% FSC certified Siberia larch supplied by Machined Timber Services. The company's Justin Dutton explains that larch is normally classed as a medium-movement wood because it moves more than cedar, but because of the open-joined profile used here — allowing for greater airflow around the boards — the cladding has greater stability and durability. Five different board sizes were used to form a barcode type pattern. Dutton says that Siberian larch is less expensive than Western red cedar and tropical hardwoods such as Iroko. "It's a very affordable cladding species – when used correctly," he says.

It's a feature that exemplifies the whole project: striking design underpinned by close – very close – attention to detail.

SELECTED PROJECT DETAILS
Architect: Peter Legge Associates (Peter Legge. Patrick Lloyd. Lisa Mc Sharry and Cornelia Hope)
Civil & Structural engineer: Casey & O'Rourke Associates
Energy consultant: Integrated Energy
Contractor: GEM Construction
Mechanical contractor: Eco Living
Airtightness & roof insulation contractor: Baker & company
Electrical contractor: HT Electrical Services
Airtightness tester: 2eva.ie
Roofing contractor: A & A Quinn Roofing
Wall, roof and floor insulation: Xtratherm
Additional roof insulation: Isover
Window blinds: Silent Gliss
Windows: Harmon Vinduer
Rooflights: The Folding Door Company
Curtain walling fabricator: Phoenix Aluminium
Curtain walling supplier: Reynaers Aluminium
Cladding supplier: Machined Timber Services
Internal timber: Keen-M
External insulation contractor: SF Plastering
External insulation render: Kilsaran
Magnesium silicate boards: Resistant Building Products
AAC blocks: Quinn Lite
Window reveals: Tegral
Wood burning stove & heating system commissioning: Eco Wood Burning Stoves
Solar thermal panels: Kingspan Solar
Underfloor heating: Unipipe
MVHR: Archers
MVHR ductwork: Lindab
Heating controls: Heat Miser
Rainwater harvesting: Shay Murtagh
Concrete floor surfaces: Ardex Pandomo
Timber floors: Keen-M
Kitchen & Joinery: Langrell

PROJECT OVERVIEW:

Building type: 298 square metre detached five-bedroom house

Location: Co Meath

Completion date: 2013

Passive house certification: certified

Space heating demand (PHPP): 14 kWh/m^2/yr

Heat load (PHPP): 14 W/m^2

Primary energy demand (PHPP): 116 kWh/m^2/yr

Airtightness: 0.6ACH

BER: Pending

Ground floor: Concrete slab with 250mm Xtratherm PIR insulation over this, finished with a concrete screed. U-value: 0.92 W/^{2}K

Timber clad walls: wet plaster airtight layer, concrete block-on-the-flat (beginning with two courses of Quinn Lite blocks), 250mm Xtratherm Warm-R insulation (150mm between vertical stud & 100mm between horizontal stud), breather membrane, vertical treated timber battens, horizontal treated timber battens with chamfered edge to allow water run-off, Siberian larch vertical treated timber cladding panels with insect mesh. U-value: 0.145.

Rendered walls: as above except RenderPro magnesium silicate board instead of Siberian Larch cladding, with Ceresit render system (flexible cement free reinforcing coat, glass fibre alkaline resistant mesh, and acrylic render with rustic rexture). U-value: 0.145
250mm closed cell XPS insulation below DPC with external render.

Timber roof section: Three different roof types, two with timber rafters and one with a concrete flat roof. The timber roofs are insulated with Metac between the rafters (sized at 175mm and 225mm respectively) and 120mm Xtratherm above. U-values: 0.14. Both of these roofs have a zinc finish (on membrane, on wbp ply, on insulation). The concrete flat roof has membrane finish on 175mm minimum (200mm average) tapered Xtratherm insulation on the precast concrete flat roof. U-value: 0.13

Windows: Protec Classic triple-glazed aluclad timber windows. Ug-value: 0.53. Uf value: 1.03

Glazed screen: Reynaers triple-glazed CP155LS HI D Mono Rail (single slider and fixed glazing). CS68 HI (openable vent)/CP155LS HI D system lift & slide (triple slider). Uf-value: 3.0. Ug-value:0.6

Rooflights: Glazing Vision Profiles with Pilkington triple-glazed units. Ug-value: 0.6. Uf-value: 1.8 Phoenix Aluminium fabricated the windows and doors. Reynaers Aluminium supplied the profiles.

Heating system: Kamin Kessel 62/76 wood burning boiler stove. 1000L stratified buffer tank, Brunner Sterring electronic control. 6 sqm, 30 tube Thermomax HP400 heat pipe vacuum tube solar collector. Individual pipes for hot water.

Ventilation: Brink, Renovent Excellent 400 heat recovery unit, 84% efficient heat exchanger, 0.31 Wh/m^3 rated fans. Specific heat recovery efficiency: 78%.

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Coastal house

Mulcaire Heffernan's latest project in Connemara drew on the skills of a highly experienced design team to create a building that doesn't compromise on anything. Despite a hugely challenging site, the house manages to take full advantage of its setting and still deliver passive standards.

Sitting at the end of a narrow road, the sloping site is home to an existing cottage perched right on the edge of the Atlantic Ocean. It's exposed, inaccessible and during the Christmas storms, it took a ferocious battering.

Contractor Niall Dolan of GreenTec Ecological Homes says that despite the fact that part of the road leading from the house was actually washed away during the storms, the client was blissfully unaware of how bad the weather actually was. "They didn't know it was even windy outside," he says, "because inside in the house with the wall build-up and triple-glazed windows, they were completely protected."

The client wished to retain the existing cottage as an annex, which essentially made this a new build project. The first difficulty facing the design team, in addition to the exposed nature of the site and its inaccessibility, was the fact that it faced exactly the wrong way.

"The classic dilemma," architect Eugene Mulcaire explains, "is you have these terrific views literally facing true north. All our solar energy is behind us." Moreover, the site's unwieldy situation made a conventional design problematic. How to create open, light-filled living areas and at the same time respond to the landscape's natural contours?

The solution was to turn the building upside down, placing the living areas on the upper floor and the bedroom spaces downstairs.

"The road to which the building relates is elevated over the landscape," says Mulcaire. "There's a very old retaining stone wall, probably about a storey tall which means we come in off the road onto the entrance level...We played with that a little bit, so that the building is approached by way of a bridge just to accentuate that idea of being elevated over the landscape."

Achieving a low energy build was as important to the client as capturing those great northern views. But conventional wisdom tells us to keep glazed areas to an absolute minimum on that elevation in order to maintain a high performance building envelope. Meanwhile, there was nothing to see on the southern elevation, where all the passive solar gains lie.

The architects came up with an elegant solution. They took a monopitch roof, then elevated the southern edge to create a clerestory consisting of high level ribbon glazing which overlooks a narrow flat roof. A white membrane on this roof converts it into a light shelf, which amplifies the southern light, directing it up into those high level windows which overlook the vaulted living spaces below.

In addition, the southern elevation features long, slot windows which are very precisely positioned to deliver light directly to kitchen worktops in one instance, and to the stairwell in another.

With the living spaces now flooded with southern light, the next step was to tackle the northern views. The solution here was simpler.

"From day one," says Mulcaire, "we pointed out

Photos: Kevin Gilmor

goes low energy against the odds

How can a house embrace passive solar principles when all the sun's heat and light is to the south — but all the best views are to the north? This striking home on the Connemara coast employed some clever solutions.

Words: John Hearne & Jeff Colley

the orientation contradiction to the clients and they were more than happy to invest significantly in a window package." They chose triple-glazed timber aluclad windows from True Windows in Sligo, which deliver a whole window U-value of 0.92. Mulcaire believes that any successful project needs to flag big ticket spends like these at the earliest stage possible. "Before even committing to specs, it's incumbent on the low energy design team to flag these contradictions and these hotspots and get a buy-in from the client very early." The window spec features double height glazing that turns the corner on the northeastern corner and a zinc-clad oriel window in the northwest.

One of the design issues thrown up by the fact that the house is inverted is that you lose the direct, natural connection with the outside. A balcony is an obvious solution, but a balcony creates a major headache for passive house designers. Any cantilevered structure, particularly one as large as a balcony, represents a major interruption in the thermal envelope. Not alone do you have a cold bridge to deal with, getting it airtight is also difficult.

Niall Dolan of GreenTec took responsibility for ▶

(below, l-r) The lean to roof includes 225 timber joists, which were pumped with cellulose insulation; an Ampac Ampatop Protecta membrane & tapes; and a 100mm service cavity with Sheep Wool Insulation inside the airtight layer; (above) an old cottage on the site was untouched and can only be used as storage space under the planning permission.

managing both thermal bridging and airtightness. He says that the Letterard house was one of the trickiest he has ever worked on, due primarily to the design features that had to be introduced to deal with the house's orientation and layout dilemmas. He explains that the balcony issue was addressed by using a customised product from Armadillo NV. "We used a special anti-cold bridging plate called Armatherm, which is a flange plate that goes in between the balcony and the receiving plate."

Installing the long-span slot windows also required a lot of what Eugene Mulcaire calls 'hidden structure'. Wherever possible, the steel systems were installed so that they didn't cross from outer to inner leaf, and so didn't break the thermal envelope.

The build method chosen was traditional with a twist: block, but with an extra-wide 250mm cavity pumped with EPS platinum bead insulation. Though other forms of construction were considered at design stage, blocks were chosen primarily because on the one hand they deliver the thermal performance required, and on the other, a block built house relies on local skills and suppliers.

"My background is commercial," says Mulcaire, "and what I've found over the years is that you can bring in clever curtain walling and low energy systems only to find out that the backup systems can be as remote as London or Berlin; all of a sudden, you have a big problem on your hands."

"When you can plug into local skills pools and local supply chains, you're going to get a bit more security attached to your endeavour."

Building in this environment and terrain brought all kinds of logistical difficulties. Getting sand down to the site required two diggers; one at the top of the hill to scoop it from the truck, and one at the bottom of the hill to scoop it onto

"What's emerging is a lot of willingness to go low energy, to drive the elemental composition as hard as possible."

the site. There was no room for the crane which would usually be used to position the hollow-core concrete floor. Instead, each slab was manoeuvred into place using a tracking machine. In order to prevent the airtight membrane from tearing during the process, Dolan used rolls of heavy-duty DPC to cover and protect it.

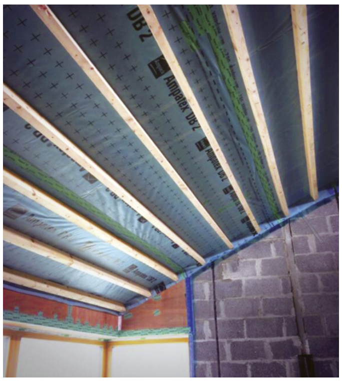
High winds meant that the membrane itself had to be weighted and temporarily fixed to the structure during the build, just to keep it from being whipped away, while blocklaying was routinely postponed, again due to the severity of the wind.

The wet-plaster finish acted as the primary airtight layer. A range of additional details were required to get the building down to the passive target of 0.6 ACH. Niall Dolan estimates that over 2km of sealing tape was used, in particular on the aforementioned structural details. Ply boxes were used behind the windows to close the cavities, and here again, extensive use was made of airtightness tapes to provide the required seals. The first and only blower door test registered a result of 0.56 ACH, comfortably inside the passive house target.

The clients decided early in the project that while they would aim for passive house standards, they would not seek certification. Eugene Mulcaire says that in recent years, the costs involved in full certification have made it a difficult sell.

"What's emerging is a lot of willingness to go low energy, to drive the elemental composition as hard as possible. But certifying passive adds to the overall cost considerably, and there's no real net gain at the moment in the marketplace."

Letterard was one of the last projects that Eugene Mulcaire's partner in the practice, David Heffernan ▶

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worked on before his death last December. Heffernan was one of the pioneers of low energy building in Ireland. A softly-spoken, disarmingly modest man, Heffernan was far ahead of the curve on sustainable building. Construct Ireland, the magazine which evolved into Passive House Plus, featured two of his exemplary sustainable projects, perhaps most notably including a substantial mixed-use scheme on Galway's Forster Street from 2006 that featured passive solar design, external insulation, triple-glazed curtain walling, airtightness, MVHR and renewables amongst other measures.

"Get the basic things right, like orientation, insulation, infiltration, and ventilation," David Heffernan told Construct Ireland in 2006. "Then you add the active measures." Heffernan's legacy makes these words manifest, including pioneering buildings of architectural quality designed to save energy and tread lightly on the planet for decades to come, and an architectural practice equipped to carry on his work into the future.

SELECTED PROJECT DETAILS
Architects: Mulcaire Heffernan
Contractor: GreenTec Ecological Homes Ltd
Structural engineers: John Britton Consulting
Mechanical contractor: Airflow Renewable Solutions
Windows: True Windows
Larch Cladding: MTS Wood Components
Zinc: Let it Rain
Airtight products: Partel
Air to water heat pump: Mitsubishi
Heat recovery ventilation: Brink
Airtightness Testing: 2eva.ie
AAC blocks: Quinn Lite
Thermal breaks: Armadillo & Ancon
Low carbon cement: Ecocem
Cellulose insulation: Sustainable Insulation Products Ltd.
Wool insulation: Sheep Wool Insulation Ltd
Foundation insulation: Xtratherm
Wood burning stove & flue: Spartherm & Schiedel
Flooring: Junkers

PROJECT OVERVIEW:

Building type: 167 square metres, two storey, wide cavity masonry build

Location: Letterard, Co. Galway

Completion date: January 2014

Budget: confidential

Passive house certification: n/a

Space heating demand (PHPP): n/a

Heat load (PHPP): n/a

Primary energy demand (PHPP): n/a

Airtightness (at 50 Pascals): 0.56 ACH at 50 Pa or 0.61m^3/m^2/hr at 50 Pa

Energy performance certificate (EPC): pending

Carbon performance coefficient (CPC): pending

BER: pending

Thermal bridging: Armatherm bolt-through structural thermal breaks were used on the cantilevered steel balcony. In addition to this the first course of all warm walls are in Quinn Lite blocks. Low thermal conductivity TeploTie cavity wall ties were used throughout. The eaves were also thermally broken using a double wall plate.

Ground floor: Traditional cold raft foundation with 140mm of Xtratherm PIR insulation board on top and 50mm isolation perimeter insulation, U-value: 0.13

Walls: Sand and cement render on concrete block external leaf with 250mm cavity pump filled with EPS platinum bead insulation with concrete block inner leaf with airtight sand and cement render. U-value: 0.12

Flat roof: Kaliko PVC-P membrane on WBP plywood on firing joist on Ampac's Ampatop Protecta membrane on 500mm twin joist 150mm top and 100mm bottom. Twin joist zone pump filled with of high density cellulose insulation, with 40mm uninsulated service cavity and 12.5mm plasterboard under. U-value: 0.09

Lean to roof: Standing seam zinc cladding on two staggered layers of 9mm OSB sheets on battens for air flow on Ampac's Ampatop Protecta membrane on 225mm timber joists pump filled with high density cellulose insulation, with 100mm service cavity filled with Sheep Wool Insulation with 12.5mm plasterboard under. U-value: 0.13

Windows: Triple-glazed, aluclad timber by True Windows, overall U-value of 0.92

Heating system: Mitsubishi Eco Ecodan Monobloc air source heat pump with a COP of 4.18 (assuming an air input temperature of 7C and water output of 35C) running with underfloor heating with stats in every room. Forecasted running cost for space heating and hot water is €320 annually.

Ventilation: Brink 400 heat recovery ventilation system — SAP Appendix Q testing 88% heat exchange efficiency

Green materials: Cellulose insulation, sheepswool insulation, all constructional timber is native and from sustainable managed sources, 50% ecocem in foundations

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19th century barn

gets 21st century fabric upgrade

Hitting Enerphit – the passive house standard for retrofits – wasn't challenging enough for one Yorkshire retrofit project. The team also had to stop the building falling down, and avoid wholesale changes to the building's external appearance.

Words: Lenny Antonelli

The Yorkshire Wildlife Trust's plan to retrofit an old stone barn at Stirley Community Farm, just outside Huddersfield, provoked a simple question: What makes a building green?

The trust bought the stone barn in 2010, after renting land around it from Yorkshire County Council. The local authority wanted the site to serve the community, so the trust talked to people living in the area. Rather than a nature reserve, locals wanted the site to be used for growing food.

So the trust developed a plan: create a traditional Pennine farm and demonstrate how to grow food in a way that maximises biodiversity and minimises carbon emissions.

With agricultural emissions soaring, the trust was keen to prove low carbon farming was possible. The group envisaged upgrading the old barn, heating it with biomass, and powering it with wind or solar.

Then the trust's staff met Bill Butcher of the Huddersfield-based Green Building Store. Bill told them about passive house, and said: "Forget all your renewables, forget your biomass, there's gas on the site."

Yorkshire Wildlife Trust CEO Rob Stoneman says: "He fairly quickly convinced me it's not how you generate the energy, it's how you use the energy." For the trust, the long-term energy and cash savings from adopting a fabric-first approach made sense. The Green Building Store came on board as passive house designer, contractor and supplier of many key products.

The project had already been developed to planning stage by EcoArc architects, whose drawings and designs were used to get planning permission and secure funding.

The trust's brief was fairly simple — it needed a large multi-purpose space for meetings and workshops, with meeting room and a kitchen for cooking demonstrations. "The layout of the building is very simple, it's one big room," Bill says.

But he points out one not insignificant problem: the original barn was found to be structurally unstable. "The place was falling down basically," Bill says.

The design team, which now included architect Derrie O'Sullivan and Stuart McCormick from SGM structural engineers, came up with a clever solution: build an insulated timber box inside the old barn, and attach it to the old stone walls with reinforced TeploTie wall ties to help stabilise the existing structure.

"The actual timber framing holds the masonry up. In effect the masonry becomes a rain screen," Bill says.

Luckily, this plan met another of the wildlife trust's key goals: that from the outside, the old barn should continue to look like an old barn.

The box-within-a-box solution didn't solve all the structural issues: one gable wall had to be rebuilt using the original stone facing, while some concrete was also cast into the existing structure to help stabilise it.

It also provoked a new question: would the design create a dew point in between the old and new structures that would encourage condensation and mould? Moisture posed a big risk: the barn is exposed to wind-driven rain, sitting above Huddersfield and looking out onto Saddleworth Moor, and the local sandstone with which the original barn was built is notoriously porous.

Bill asked engineer Niall Crosson of Ecological Building Systems to perform a dynamic moisture simulation of the structure using the Wufi software.

Crosson's advice? If the space between the old and new structures was ventilated, moisture shouldn't pose a problem.

To ventilate the cavity, Bill installed plastic air bricks at ground and eaves level in the old barn walls. He also wrapped the timber structure inside with Pro Clima WA vapour permeable membrane for a belt-and-braces approach. Leeds Metropolitan University has installed moisture monitors in the timber wall and cavity to keep an eye on moisture build up.

Inside, the timber frame is insulated with fibreglass. Green Building Store would have preferred a more natural material, but the budget wasn't available. Spano VapourBlock boards, an alternative to OSB, provides the airtightness layer in the walls.

The Spano boards in the walls line up with OSB in the roof — which is taped with Pro-Clima tapes — to create a continuous airtight layer. Above this the TJI joists are insulated with polystyrene, with Gutex wood fibre board providing a breathable wind tight layer over this. Outside, the roof is clad with industrial metal, typical of barns in the area.

The roof was completely rebuilt apart from the existing trusses, and sits on the old stone walls rather than the timber frame. This means the trusses and purlins penetrate through the thermal envelope, the building's only major thermal bridge.

Downstairs, the ground floor is insulated with two 100mm sheets of polyurethane insulation, which were carefully taped and jointed. To cut out thermal bridging, the new concrete slab is structurally independent of the stone walls, and is encased in a tub of polyurethane insulation. The edges of this tub join up with insulation in the walls to create a continuous thermal layer.

Green Building Store installed Optiwin Alu2Wood passive house certified windows throughout the barn. Certified windows were crucial, as Green Building Store is going down the 'elemental' route to Enerphit certification. Rather than hitting the Passive House Institute's targets for whole-building heat consumption, each building element will have to meet a specific energy performance target. The whole window installed U-value must be no worse than 0.85.

This meant the team had little flexibility when it came to choosing components — they couldn't, say, compensate for mediocre windows by beefing up the insulation in the walls, or vice versa.

"Every element has to be of a certain performance level, you can't play one off against another," Bill says of this approach to certification.

This approach is designed for retrofit projects in which designers have no control over a major aspect of the build — such as the orientation, window sizes and positions, or ceiling height.

The team had no choice but to take the elemental route. A structural survey had revealed flaws in the barn's foundations, so Green Building ▶

Photos: Green Building Store

Store had to install a two-level ground floor instead of the single level they originally planned. This meant ditching the plan for an extensive first floor, meaning the ratio of envelope-to-floor-area went up. The orientation wasn't ideal either, so hitting the 25kWh/m^2/yr Enerphit standard for space heating became untenable.

When it came to ventilation, the barn posed a challenge: the system must be able to adapt to huge variations in demand, being empty much of the time, then suddenly filling up with 20 or 30 people for a workshop.

Green Building Store installed two Paul Novus 450 passive house certified MVHR units. The first unit supplies the main hall. When the building is unoccupied this runs at fan speed one, but when it's in use staff turn the ventilation rate up to speed two. If relative humidity goes above 80% or CO_2 goes over 1400ppm, the system goes into boost mode — speed three.

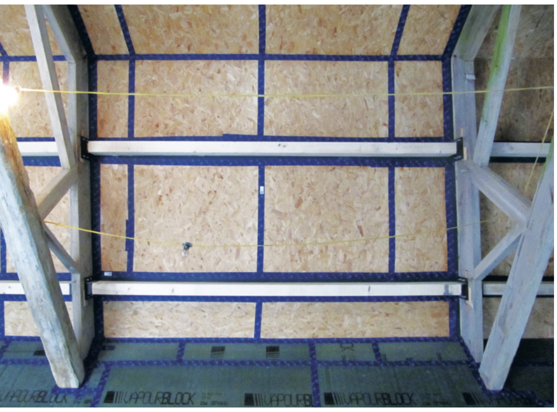
If the main hall is packed and the first unit can't provide enough ventilation, the second Novus — which ordinarily only ventilates the meeting rooms — enters boost mode and starts supplying fresh air to the hall too.

Rob Stoneman is impressed by the quality of air inside: "Bill said this would be the case, and I didn't quite believe it, but it feels really fresh, it's really noticeable. You go in and you're just feeling warm outdoor air rather than indoor air."

Rob originally wanted to heat the building with wood, but Green Building Store persuaded the trust to go for a cheaper gas boiler, and to put the money saved into the building envelope instead.

Bill knew that, although the building wouldn't need much heat, there might be times when hot water demand skyrocketed. So the team installed a fairly big Vaillant 12.9kW boiler — even though only 2.2kW is needed to heat the barn when it's -10C outside. Putting in a large boiler with lots of radiators and a big volume ▶

"It feels really fresh, it's really noticeable. You go in and you're just feeling warm outdoor air rather than indoor air."



of water means the boiler won't cycle, and the lower return temperature helps the boiler run as efficiently as possible.

"An additional advantage of using such a simple heating system is that every plumber in Huddersfield will know how to maintain and fix it if it breaks down. For maintenance purposes, it's the easiest option," Bill wrote on his blog about the project at passivhausblog.co.uk

Inside, staff can control the temperature with a simple room thermostat that's set at a constant 19C.

Since the barn opened last September, there's been a little overheating in one of the meeting rooms. This was caused by two wireless routers sitting next to the boiler interfering with the controls, and has now been sorted.

Bill says that structural issues with the foundations, the state of the existing masonry, and the need to stabilise the old walls made the barn — dubbed the Cre8 Barn — a tougher project proposition than Green Building Store's new build passive house, Denby Dale.

But Stirley Farm will get there in the end: Its airtightness test came in at 0.33 air changes per hour, and Enerphit certification is pending.

Derrie O'Sullivan has brought students from the University of Huddersfield here to show them what passive house and Enerphit is all about.

"Taking people on site and touching and feeling, there's no substitute for that," he says. "It's about spreading the good word really.

"You say: 'What's different about this, gosh it feels comfortable, what is it?'"

The Yorkshire Wildlife Trust is now using the Cre8 Barn to teach people how to grow and cook food in a sustainable manner. Hardy shorthorn cattle grazed the farm, the trust is planning to improve meadows and restore wetlands, hedgerows and old stone walls on the site.

"We gave [Green Building Store] a fairly tight budget to work to and they've been absolutely brilliant in sticking to it," Rob Stoneman says.

"Through the winter it was beautifully warm," he adds. "It just feels really nice, I think it's super."

SELECTED PROJECT DETAILS
Clients: Yorkshire Wildlife Trust
Main contractors & passive house consultants: Green Building Company
Architect: Derrie O'Sullivan
Pre-planning design/architecture: EcoArc
Structural Engineer: SGM Structural Engineers
Windows & doors, airtightness products & MVHR: Green Building Store
Wood fibre insulation & building boards: Ecological Building Systems
Thermally broken wall ties: Ancon
PUR insulation: Xtratherm
LED lighting: LEDHut
Quantity surveyors: WHP
Airtightness tester/consultant: Centre for the Built Environment, Leeds Metropolitan University
Gas boiler: Vaillant

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(clockwise from above) The Spano boards in the walls line up with OSB in the roof — which is taped with Pro-Clima tapes — to create a continuous airtight layer. The roof is insulated with 5mm polystyrene, two layers of 200mm fibreglass insulation and 60mm Gutex Ultratherm acting as a sarking board; reinforced TeploTies were used to connect the timber box to the original structure; Compacfoam CF200 strengthened EPS insulation provides a thermally broken foundation at door thresholds.

PROJECT OVERVIEW:

Building type: Restored 19th century stone barn. Timber frame 'box within a box' construction

Location: Education Centre at Stirley Community Farm, Yorkshire Wildflife Trust, Huddersfield, West Yorkshire

Budget: £190K +VAT (construction costs)

Enerphit certification: Seeking Enerphit certification as a 'Quality Approved Energy Retrofit with Passive House Components' due to the restrictions of the existing building.

Space heating demand (PHPP): 41 $kWh/m^2/yr$[1] (based on treated floor area of $98m^2$)

Heat load (PHPP): 16 W/m^2

Primary energy demand (PHPP): 103 $kWh/m^2/yr$

Airtightness: 0.35 air changes per hour @50Pa

Ground floor: two x 100mm sheets of Xtratherm polyurethane insulation, carefully taped and jointed. New concrete slab structurally independent of stone walls, encased in a tub of polyurethane insulation. Edges meet wall insulation to create an continuous thermal layer.

Walls
Before: 450mm rubble-filled stone walling
After: 450mm rubble-filled existing stone walling, nominal 50mm ventilated cavity, timber frame 'box within a box' made up of: Pro Clima WA membrane taped with Tescon Vana; 60mm Gutex Multitherm wood fibre insulation; 241mm TJ joists at 400mm centres (fabricated on site in 2400mm wide cassettes); 250mm fibreglass insulation (with 0.04 lamda value); airtightness board Spano VapourBlock, taped with Pro Clima Tescon Vana; 50mm service void; plasterboard & skim. U-value: 0.129

Roof
Before: agricultural barn roof
After: Corrugated steel industrial roofing; 50mm X 50mm softwood battens; 25mm x 50mm softwood counter battens; 60mm Gutex Ultratherm. wood fibre insulation & sarking board; 2 X 200mm fibreglass insulation (with 0.04 lamda value); 25mm EPS polystyrene; 406mm TJ joists; 18mm OSB board taped with Pro Clima Tescon Vana; plasterboard & skim. U-value: 0.097

New windows & doors: New triple-glazed windows: Optiwin Alu2wood triple-glazed aluminium composite windows and doors with slim frame and sightlines: Overall whole window U-value (installed): less than 0.85

New heating system: Vaillant Ecotec combination boiler

Ventilation
Before: A barn with no windows
After: Paul Novus 450 Passive House Institute certified to have heat recovery rate of 94.4% @ $145m^3/h$ or 93% @ 200 m^3/h

Green materials: Gutex wood fibre insulation, timber frame

[1]Note: provisional pre-certification PHPP figures only

PASSIVE RETROFIT EMERGES FROM ASHES OF 80s BUNGALOW

If you've ever wanted to take a passive house for a road test, one holiday letting on the coast of west Cork may be too good an opportunity to turn down. The aptly named Sea Spray – an as yet uncertified Enerphit upgraded bungalow – is a bona fide triumph in the face of adversity.

Words: John Hearne

Doris Knoebel had always been interested in sustainable living, and was a long time reader of Construct Ireland, the precursor to Passive House Plus magazine. She never imagined that she would have the opportunity to build sustainably. Then her holiday home in Clonakilty burned down.

"There were people staying in the house. They put some hot ash into the landfill bin and left for Dublin. My neighbour rang me and said, 'Doris, I think your house is on fire.'"

The bin sat right beside the oil tank, which Knoebel had only just filled. "You had hundreds of litres of oil in the tank, so it exploded like a napalm bomb. I don't know how many fire brigades had to be called out, but at that stage, the fire had been pushed by the wind underneath the eaves of the house, so it started to burn from the top down."

When the smoke cleared, only the four walls of the house were left standing. Now faced with the necessity of rebuilding, Knoebel decided that this was an ideal opportunity to do the job sustainably. After interviewing several local contractors, she approached the experienced sustainable builder Tim O'Donovan and asked him to take a look at the house. O'Donovan, recognising that this was an opportunity to implement the passive house retrofit module, Enerphit, asked sustainability expert Xavier Dubuisson to take a look. Between them, Knoebel, O'Donovan and Dubuisson worked out a plan to turn the burned out shell of the house into a super low energy retrofit.

"The cost of getting an architect was prohibitive," says Knoebel, "so I did all the project managing myself. My husband Tim, who is a graphic designer and artist, and I did all of the design work, the electrical designs, the outside designs, plus I sourced everything we needed for the build."

The site had advantages and disadvantages. On the plus side, the living areas already faced full south to take advantage of passive solar gains. On the downside, access was difficult. Squeezed between two other houses below an access road, everything that went into or came out of the house had to travel up or down a six foot wall.

Photos: Tim Booth

O'Donovan's first job was to clean the shell out, taking everything from furniture to flooring and tiles, leaving nothing but the bare four walls, which remained largely undamaged and structurally sound.

"By the time we got it back to the four walls", says O'Donovan, "we had a clear vision of how we were going to go about it." This was a seventies built bungalow, and was a showcase of the poor building practises that were common at the time. O'Donovan explains that the gables were not finished properly, while a poured concrete screed held the studwork in place. "That proved a bit of a dose for us, because we had to break all those screeds up."

The floor was where the build hit one of its biggest challenges. An existing ring beam at the top of the masonry wall defined the height of the ceiling. This meant that if the team wanted to install the optimal depth of insulation in the floor, they would have to go down. That would have meant breaking up the subfloor, which would have added substantially to the cost, and lead to the possibility of having to underpin the walls.

"That was the one area where we went: right, we'll have to call it on the floor detail," says O'Donovan. When his team got down to the subfloor, they battened it off at 400mm centres with a 50mm batten, insulated it with Xtratherm and covered that with 18mm OSB to give a finished floor. This delivered the necessary 2.4m ceiling heights in the three rooms which were not vaulted. However, with a less-than-ideal level of insulation in the floor, the necessary corollary was to compensate in walls and ceiling. The walls were pumped with bead, and this was then supplemented with 150mm of Rockwool external insulation, while the internal walls were drylined with 40mm of hemp wool.

Xavier Dubuisson explains that because both Doris and Tim were so knowledgeable, his involvement in the project stayed at quite a high level. His primary responsibility lay in putting the design through the passive house software PHPP and working through the specs. "Getting to the Enerphit standard wasn't a conscious objective at the outset," he says, "but we realised quite quickly that it was a possibility."

Dealing with thermal bridges is frequently fraught with problems in a retrofit. At floor level, Xtratherm insulation was laid all around the perimeter, and outside, a trench excavated around the walls allowed the external insulation to be installed below the level of the floor. Cellulose insulation in the roof comes down to meet the external insulation at the wall.

"Any time we came to an external wall junction," says O'Donovan, "we'd do a thermal bridge detail anyway, as par for the course."

The existing wet plaster finish provided the main airtightness layer. Thereafter, O'Donovan's team went around and meticulously patched any cracks with an airtight plaster. A new service cavity on the inner leaf removed the need for the old chasing and plug holes, so these too were filled in. Once the floor junction detail was complete, the airtight membrane was sealed in place with tapes and mastic. Similarly, the roof membrane which extended down onto the masonry wall was also sealed with a premier mastic and tape. The service batten was fixed with express nails which were then sealed with mastic.

"If you are aiming to get down there to Enerphit airtightness levels, you've got to pay attention to detail like that," says O'Donovan. As a company, O'Donovan is very much focused on personal supervision of every project and making sure that someone is on site throughout the build.

"Getting to the Enerphit standard wasn't a conscious objective at the outset, but we realised quite quickly that it was a possibility."

The first blower door test delivered a result of 0.8 ACH, comfortably inside the Enerphit target of 1 ACH, and this despite the fact that the test uncovered several leakage hotspots. It turned out that an internal chimney breast, which O'Donovan had thought was unconnected to the cavity, was actually tied to an external wall and during the test, air was drawn through it. In addition, a vent in the attic, which is inside the thermal envelope, was forgotten behind tools and boxes and was never covered up.

Finally, the hinges of some of the tilt and turn windows leaked air during the test. All of these issues were addressed afterwards, and though ▶

no further blower door tests were carried out, O'Donovan believes that the air change rate is now significantly lower.

Responding to substantial falls in the cost of solar photovoltaic panels, Knoebel installed a roof integrated solar PV system supplied by PV Tech in Galway. Mike O'Rourke of the company anticipates an annual power output of just over 3,500 kWh. "There's an additional control unit installed with the system. This takes power that's not being used by other devices in the house and rather than letting all of the excess power out to the grid, it diverts it to water heating." Once the hot water tank is up to temperature, any additional excess power is then exported to the grid.

Though PHPP calcs show that the house meets the Enerphit standard, with a heating demand of 23 kWh/m^{2}yr, Knoebel is undecided about actually pursuing certification.

The building was seriously tested during the Christmas storms but performed exceptionally well. "It works," says Knoebel. "When it was very cold outside, there was a constant temperature inside. It's an amazing house, it's just stunning. I'm very happy with it."

For information on booking a stay in Sea Spray visit bit.ly/1uLqDIg

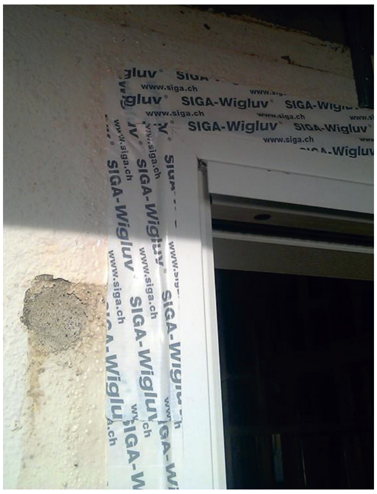
SELECTED PROJECT DETAILS
Clients & project managers:
Doris Knoebel & Tim Booth
Builder & ventilation contractor:
Sustainable Building Services
Plumbing contractor:
Paul O'Regan Heating & Plumbing
External insulation contractor:
Grainger Energy Solutions
Passive house consultant:
XD Sustainable Energy Consulting
Quantity surveyor: MMC Chartered Surveyors
Electrical contractor: Gerard O'Sullivan

"The existing wet plaster finish provided the main airtightness layer"

(below) Siga's airtightness products were used to help deliver an airtightness of 0.8 ACH, including Majpal membranes with Sicrall and Wigluv tapes; (bottom right) an Aldes Cube MVHR system provides ventilation while recapturing heat from stale air.

(opposite, clockwise from top) Builder Tim O'Donovan and client Doris Knoebel; height restrictions meant only 50mm of Xtratherm insulation could be installed in the floor; the door threshold was brought forward with thermal blocks and an external air feed pipe fitted for the stove; the walls are externally insulated with 150mm of Rockwool.

Cavity wall insulation: A1 Insulation
Hemp insulation: Ecological Building Systems
Cellulose insulation: Ecocel
External insulation system: Weber/Rockwool
Floor insulation: Xtratherm
Airtightness tapes & membranes: Siga
Windows: Senator Windows
Entrance doors: Munster Joinery
Wood burning stove: Inis Stoves
MVHR supplier: Aldes
Solar PV: PV Tech
Recycled roofing slates: Athy Ecoslate
Zinc flashing: Wychbro
Kitchen & fitted furniture: Toby Hatchett



PROJECT OVERVIEW:

Building type: 114 m^2 treated floor area, seaside bungalow originally built in the 1980s as holiday home. Full refurbishment of the building after extensive fire to meet the Enerphit standard.

Location: Ballinglanna, Clonakilty, Co Cork

Completion date: April 2014

Budget: not disclosed

EnerPHit certification: not certified

BER
Before: unknown
After: B3 BER (when supplementing more realistic figures for default values, eg with regard to solar PV output, the BER is an A3 bordering on A2 at 52 kWh/m^2/yr energy value).

Space heating demand
Before: not available
After: 25 kWh/m^2/yr

Heat load
Before: not available
After: 15 W/m^2

Primary energy demand (PHPP)
Before: not available
After: 80 kWh/m^2/yr (minus 69 kWh/m^2/yr primary energy conservation by solar PV system).

Airtightness (at 50 Pascals)
Before: unknown
After: 0.8 air changes per hour (one test only, expected to be below 0.6 AC/hr after remedial measures taken).

Ground floor: Restricted to 50mm Xtratherm PIR insulation at 400mm centres. U-value: 0.28

Walls
Before: concrete block walls with empty 100mm cavity. U-value: 1.0 W/m^{2}K
After: 40 mm Thermohemp insulated service cavity internally, 100mm injected Platinum EPS bead insulation in the cavity, plus Weber external insulation system featuring 150mm Rockwool external insulation and acrylic render. U-value: 0.12

Roof
Before: Roof slates to sloped areas. 150mm mineral wool insulation on the flat between roof joists and plasterboard ceiling internally. U-value: 0.333
After: Warm roof. Service cavity insulated with 40 mm hemp insulation, followed above by 400 mm cellulose insulation between TJI rafters, breathable roof membrane, battens and counter-battens, eco-slates. U-value: 0.10

Windows & doors
Before: double-glazed, PVC windows and doors. Overall approximate U-value: 2.1
New triple-glazed windows: certified passive Schueco windows and sliding doors and Munster Joinery entrance doors. Overall U-value of 0.80

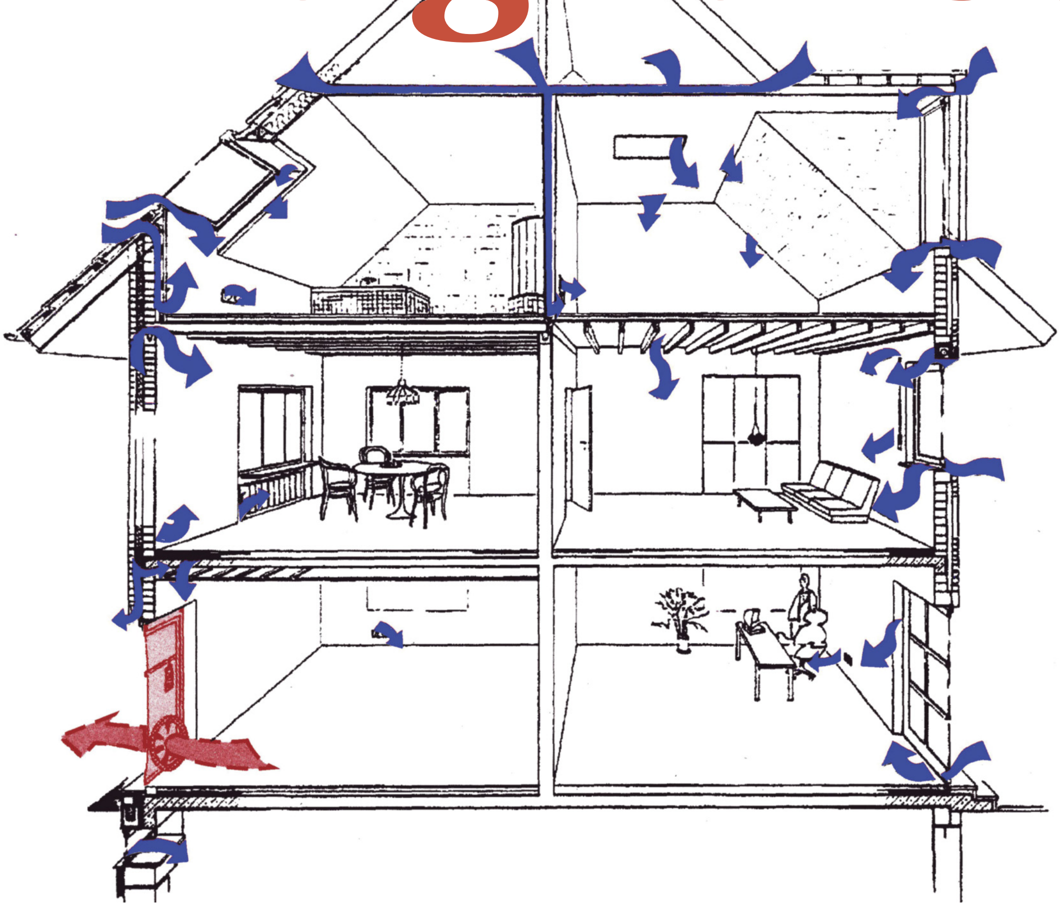
Heating system
Before: 15 year old oil boiler & radiators throughout entire building
After: INIS Oirr (made in Ireland) 12 kW room sealed wood stove with back boiler, servicing 7 radiators. 75% efficient.

Ventilation
Before: no ventilation system. Reliant on in-filtration, chimney and opening of windows for air changes.
After: Aldes Cube heat recovery ventilation system, humidity controlled, 91% nominal efficiency.

Green materials: Recycled polypropylene slate, all timber structure from PEFC certified source, cellulose insulation for warm roof insulation, hemp insulation for drylining, all fascia and rainwater goods made of recycled zinc.

Electricity: 4 kW solar photovoltaic array, roof-integrated, with expected annual output of 3600 kWh.

Airtightness



the sleeping giant of energy efficiency

A building's airtightness test result isn't just an indicator of its energy efficiency – it's an unambiguous indicator of build quality. With a little care in design and on site, airtightness targets that may seem impossibly tough are anything but, argues leading architect and certified passive house designer **Simon McGuinness**.

Image: Dirk Hasenack

There are 1.3 million[1] two-storey houses in Ireland – and over ten times as many in the UK – which must be retrofitted in order to reduce their impact on national carbon emissions, reduce fuel imports and to mitigate the impact of rising energy costs on fuel poverty. Done well, this retrofitting will have massive positive impacts on public health, the domestic economy and on Ireland's and the UK's balance of payments.

Many of the measures we need to undertake are expensive and disruptive. Many have short lifecycles and will need frequent maintenance throughout that short life to keep them running efficiently. But some are free, easily won and long lasting. Airtightness is one of those free gains which is not properly understood or valued. This is partly due to inexperience with building tightly, and partly due to confused responsibilities for the delivery of airtightness. The aim of this article is to cast new light on both of these areas.

Measurement

'You can't manage what you can't measure'[2] is the fundamental tenet of performance management. When it comes to buildings, airtightness is one of the performance indicators we can measure very accurately. We even have an international standard[3] describing how to measure it and national accreditation bodies ready[4] to enforce proper standards on the independent testers of airtightness. Everything we need is in place, we just choose not to measure every building. Why?

I think the answer to this lies in part within the building regulations. It is a basic presumption of the regulations in the UK and Ireland that necessary background ventilation can be provided partly through leaky construction. Why else would it be necessary to increase the area of designed background ventilation openings in the event that an airtightness test returns a leakage rate of less than 5 $m^3/h/m^2$? If you build tight in Ireland, you have to compensate by drilling more and bigger holes in the fabric to let air in. This is a fundamental contradiction and a contradiction that militates against building tightly. Furthermore, if you claim the energy advantage for building airtight in Ireland's Building Energy Rating, then you are required to test every dwelling in a development. If, on the other hand, you build to 7 $m^3/h/m^2$ at 50 Pascals, you have to test just one in 20 dwellings. So the prejudice against airtightness is reinforced.

Don't get me wrong – there is a need to provide adequate ventilation in all buildings, depending on occupancy levels and the use of the building. However, the presumption that a building with a q50 permeability of 5$m^3/h/m^2$ is a healthy building but a more airtight one poses a danger to human health is false. Quite the opposite in fact, as the migration of humid air through the fabric that is measured in an airtightness test, may actually indicate a risk of interstitial condensation and its potential consequence: hidden mould growth. Leaving aside hygrothermal concerns and dealing only with ventilation, we need to move towards a regime where indoor air quality is measured, not presumed; where carbon dioxide and humidity are routinely monitored and fresh air introduced as and when required, and in the precise quantity required.

Fortunately, the technology to achieve this is simple, robust, reliable and relatively inexpensive (in fact, it will pay for itself many times over in

energy savings). It requires no human intervention to activate and no electrical power to open or close the vent. Known as demand controlled ventilation, this technology is not even mentioned in Part F of the Irish building regulations technical guidance documents (TGDs), last updated only five years ago. This is a startling omission.

So, we have a cultural problem. We can perhaps fix the TGDs in time. Meanwhile the DCV deficiency can be bypassed by employing a suitably qualified mechanical services engineer to design a whole building mechanical ventilation solution to international engineering standards using DCV and certifying it as compliant with building regulations — if you can find such an engineer with residential experience. However, no case law exists as yet to confirm an Irish court's view of this approach. In that context, the new Building Control (Amendment) Regulations[5], introducing self-certification and very strict compliance requirements in Ireland (and as yet unknowable penalties for transgressions), is likely to result in even less willingness on the part of professionals to find such creative solutions to obvious gaps in the official guidance.

Inexperience
Having established that regulatory context, let me now address the issue of inexperience. Because we tend to build leaky buildings, we have few professionals able to design and specify airtight construction. Nor, without a demand for such airtight forms of construction, is there much opportunity to develop the trade skills required to deliver them on site. The Irish construction industry is trapped in a morass of low standards and a sheriff-and-cowboys attitude to compliance, some of it attributable to disjointed regulation, more of it to the effects of endless and catastrophic boom-bust cycles. A 2008 study suggests that Irish standards of airtightness are actually getting worse[6].

One of the factors not adequately addressed in Irish regulations is the influence of our exposed geography. We live on a low-lying outcrop on the edge of the fierce north Atlantic weather system. We have the fourth best wind energy potential on the planet[7]. A windless day is something we only read about. Here, a small leak produces a big effect, significantly over-ventilating our buildings at certain times of the year, usually when least required – Ireland is about the last place in the world where passive ventilation (hole-in-the wall) is appropriate, particularly in the context of rapidly rising energy costs. Yet, we cling to this so-called natural ventilation as if to a long handed-down tradition.

In fact, it's a relatively modern addition to our building codes, and largely a response to an epidemic of TB which swept Ireland in the 1950s. Excessive ventilation remains a key component of TB infection control to this day[8]. However, in the absence of a TB epidemic, the threat of icy draughts caused by over-ventilation of Irish houses may now be a bigger factor in excess winter death statistics, due to its impact on people with heart conditions[9]. The predictable response of householders to excessive designed-in draughts is to block vents, thereby endangering indoor air quality. This trend is exacerbated by rising heating bills. There is a need for a systematic study of the impacts on human health of the various forms of ventilation found in Irish homes. The current "natural" ventilation provision may actually be killing more of us than it is saving.

The passive house movement was the first to identify air leakage as an unnecessary component of buildings designed for human health and comfort. Adequate continuous ventilation is provided to meet the needs of occupants, but nothing more. In this way, ventilation heat losses can be restricted to what is required for good health of both the human occupants and the building fabric surrounding them. Unsurprisingly, hole-in-the wall vents are not part of passive house design. Ventilation is provided by a system of whole-house, balanced, mechanical ventilation with heat recovery. In order to meet the energy and comfort targets, the Passive House Institute set 0.6 air changes per hour as the maximum air leakage allowed in the building fabric. For most houses this equates to an aggregated leakage area about the size of a smartphone. There is also a requirement for opening windows to allow for purge ventilation, as required. This results in an intelligent balance of comfort, health and energy conservation.

Building to that standard is not easy, especially if you are an Irish or British builder steeped in the practice of constructing leaky buildings. It is therefore of interest that one such builder, Michael Nally & Sons of Galway, has produced a building with a leakage rate of just 0.37 ACH. That it was their first serious attempt at building tightly speaks volumes for the potential of the sector to deliver unimagined standards of construction quality, if the regulatory and contractual environment were supportive. What's more, this result was achieved in a retrofit project. I think it's time to reconsider our assumed horizons on airtightness. If that test result is possible with an inexperienced but diligent contractor, who knows what they could deliver with more experience?

In an effort to promote building tightly[10], I'd like to share with you the methods employed to achieve that airtightness result. For most projects, building to such standards will not be economic or necessary. But every project will benefit from tighter construction where the wins are free, or low cost. My hope is that capturing those free wins becomes the norm, and that they will result in improved building energy ratings, for little or no additional cost.

Case study — allocation of responsibilities
The house is a four bedroom semi-detached 1960s home built in a small suburban estate in Salthill, Galway. It was constructed with 300mm cavity walls containing a 100mm uninsulated air cavity. The intermediate floor is timber-joisted and the roof is a timber-trussed with concrete tiles. Windows throughout were single-glazed and aluminium framed. The ground floor was concrete slab on grade with no insulation. There are hundreds of thousands of similar houses all across Ireland. If we can't make these and the rest of Ireland's 1.3million two-storey houses nearly zero energy by 2050, we'll have to demolish and rebuild them from scratch. That would destroy the embodied carbon in the materials already present, produce additional carbon emissions for its removal to landfill and add the further emissions penalty of building a new replacement dwelling. A veritable carbon triple whammy.

The client's desire was to retrofit the house to passive house standards. I designed the layout and specified the fabric upgrade using the PHPP software. External walls were pumped and externally insulated, the ground floor slab was removed and replaced, and the roof was insulated. The airtightness strategy adopted involved five key principals:

- Completely intact plaster layer on the external walls from floor slab to first floor ceiling
- No chased services of any kind on the external walls
- Airtight membrane under the first floor ceiling with a battened services cavity below
- Passive house certified windows and doors taped to walls/floor under plaster layer
- All unavoidable service penetrations of the airtight layer sealed with grommets
- Complete removal of the chimney down to foundation level

The airtight layer was drawn in blue on all plans, sections and details and called up in detail in the various specification notes issued for tender. Photographs were included to show the sequence of operations of installing critical components of the airtight layer. If it's not drawn or described in the tender, it can't be insisted on during construction.

The entire ground floor ceiling was removed on my advice before the tender drawings were commenced, and the locations of all joists to ▶

(above) Airtight ceiling membrane with cable services cavity beneath & plastered partition junctions. Standard polyester scrim was applied to the new ceiling/wall junction and skimmed over, covering the Tescon tape joining the Intello membrane to the plaster face of the wall; (below) Plastered up intermediate floor joists, taped to new plaster. One floorboard and upper skirting board removed to allow for plaster continuity between floors. The preservative treatment applied to joist ends is historic and is unnecessary given that the junction is now airtight and, as a result of external insulation, the entire inner leaf of the wall is retained at above 17C all year round. All risk of interstitial condensation around the joist ends is therefore eliminated.

the intermediate floor were surveyed and drawn. This proved invaluable in designing the layout of piped and ducted services within the intermediate floor zone and in avoiding clashes or cross-overs within the limited floor depth available. It also allowed the engineer to design the structural interventions required to allow the extensive modification required to the room layouts. Steel beams inserted into the intermediate floor zone were pre-drilled to allow pipework to pass through at a later stage of the construction. All internal block or partition walls abutting the external walls were cut back by 300mm min, the plaster layer made good and the abutment reformed.

The first floor partition heads were identified as a significant air leakage risk location, the ceiling having been installed within each room after the partitions were erected. Many were drilled for cables. All cables were removed and the head frames were specified to be taped over from above in order to join the upper surface of each ceiling to its neighbouring area of ceiling over the head of the partition. In the event, the contractor decided to remove all the first floor partitions in order to get a single continuous Intello Plus airtight membrane throughout the space. The studs and noggins were then reused to rebuild the partition walls. The client took that opportunity to improve the layout.

The existing Stira folding attic access stairs was relocated and a new frame and insulated lid added above it to produce an airtight seal. The insulated lid is tight fitting, the attic hatch and ladder unit is not, nor can it be made tight fitting. There is a market for someone to design a standard attic hatch with a U-value of at least 0.1 W/m^{2}K, probably with upper and lower hatches, and containing a small landing area in between. The version specified, and faithfully produced on site, is functional but so tight fitting that it would not encourage anything other than periodic necessary maintenance access to the roof space. The attic is now a cold windswept desert with restricted headroom thanks to 400mm of mineral wool quilt: it is time to find somewhere else for the Christmas tree!

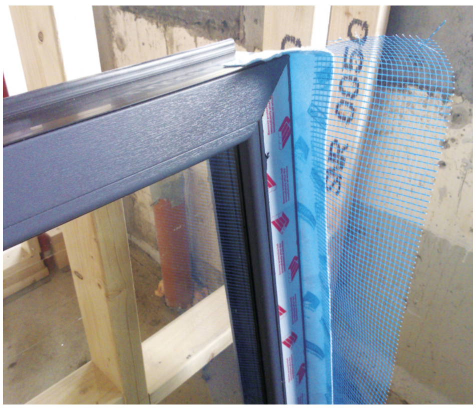
The skirtings were removed and the plasterwork extended to ground floor level. The intermediate floor abutment with joist end buried in the external walls was wet plastered. Once dry, the joints between the new plaster and the existing joists were taped up with Tescon No1 tape.

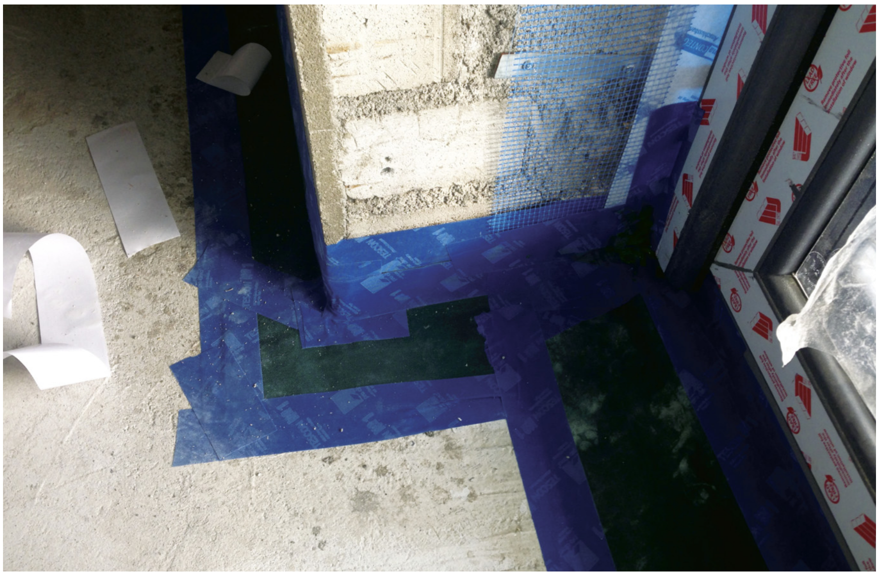
The sequence of window installation is instructive and relatively simple.

- The window was laid flat on a trestle
- Airtight Contega tape was applied to back of the two sides and head frames
- Flat stainless steel brackets were attached to the window frames through the airtight tapes
- The window was installed and adjusted.
- The external insulation system was completed
- The reveals were plastered up with gypsum bonding
- 18mm OSB sub-cills were fitted and taped to window frame and to the plaster face
- The first blower door test was carried out (Result: 0.67 ACH)
- The cill boards were bonded to the sub-cills
- The reveals and head were then skimmed.

(below, l-r) Airtight tape applied to back of window frame lapped around four corners; Fixing bracket attached over airtight tape. The stainless steel brackets are fixed to the masonry reveals and plastered over; Window installation awaiting completion of external wall insulation. Rain infiltration at this stage would weaken the bond between reveal plaster and the airtight tape so internal plastering is delayed.

(opposite) Extra thick slab-edge insulation creates airtight taping difficulties at floor/wall junction, particularly under depressurisation when tapes can detach from the concrete substrate; Airtight ductwork penetrating airtight first floor ceiling to serve upper floor bedrooms.





The ground floor slab-to-wall junction proved to be the most difficult place to achieve airtightness. The width of the edge insulation (50 to 100mm) required the use of extra wide Tescon No 1 tape, but the cut edge of the Kingspan Kooltherm board was not sufficiently smooth to adhere the tapes to, and under depressurisation these tapes lifted. (In future I'll specify that these board edges are to be wrapped in foil tape before being fitted to provide a good surface for the airtight tapes to adhere to.) The edge of the concrete slab also proved difficult to achieve good adhesion on, in spite of using the recommended concrete sealer and bead of mastic. (In future I'll specify a two-pack epoxy levelling compound to the floor edge to produce a smoother surface for taping to. I'll also consider reducing the thickness of edge insulation in this area, given the fact that the external wall insulation extends to foundation level). The second blower door test produced a result of 0.37 air changes per hour.

The MVHR system proved to be an unexpected challenge in achieving the airtightness rating. These systems are really designed to be contained entirely within the airtight envelope: they do not have the airtightness required to allow for ductwork terminations and air valves to protrude through the airtight enclosure, even if taped around. While it doesn't need to be included in the airtight test (Gavin O Sé's free on-line guide at greenbuild.ie was invaluable in teasing this out[11]), excluding the MVHR system required partial disassembly and extensive temporary taping of junctions, tube ends and terminal boxes. Another lesson learned expensively was that the final intake and exhaust terminals should only be fitted after the final pressure test is complete, as it is much easier to seal a protruding duct rather than a plastered-over wall vent terminal pushed through a mineral wool EWI system.

In future, I would contain all the ductwork within the airtight envelope, even restricting it entirely to the intermediate floor zone, if at all possible. A 3D BIM model of the services and the structures in this intermediate floor will be invaluable for getting it all to fit and communicating the requirements to the contractor, the structural engineer and the client. Fitting it is the easy bit.

In hindsight, we had the space to drop the first floor ceiling by 100mm (we had 2500mm floor to ceiling height) and this would have been a better option than penetrating the airtight layer, running ducts in the attic and penetrating the airtight layer again at each terminal box. We used the prefabricated jointless flexible duct system produced by Zehnder to match our Comfortair 350 MVHR unit, assuming it would be airtight to passive house standards. While it was much more airtight than fabricated metal ductwork, which can leak at every intermediate joint along the route, the blower door test revealed joints within each metal vent terminal box which leaked air.

I had not expected wet plaster bonding to be such a simple, adaptable and effective airtightness component. The plastering trade should embrace their emerging leadership role in delivering airtightness on site. Indeed, the decline of airtightness in masonry construction is directly attributable to the decline in the application of wet plaster: drylining, insulated or otherwise, is not airtight.

I expect that builders will find it convenient to purchase simple pressurisation equipment such as the Zephair Pre Pro, glaze it into a window frame and run it frequently during the course of construction to assess progress towards the performance target defined in the building contract. The independent tester's role will then simply be to confirm what has been achieved. This also allows each subcontractor's contribution to airtightness performance to be assessed before they leave site (plumbers and electricians take note).

Sadly, Irish construction will not improve under the current regulatory regime which is — on the basis of this result[12] — severely lacking in ambition. The cost of additional renewables, or additional insulation, to compensate for excessive air leakage is an unnecessary expense and contributes to global resource depletion. It's time for a rethink.

[1]Sustainable Energy Ireland, Five Year Strategy, http://www.seai.ie/Publications/SEAI_Corporate_Publications_/Strategy_Documents/launchdoc.pdf
[2]Peter Drucker: You can't manage what you can't measure' http://www.ncc.co.uk/article/?articleid=15472
[3]I.S. EN 13829:2000 - Thermal Performance of Buildings – Determination of Air Permeability of Domestic Buildings – Fan Pressurization Method.
[4]In Ireland, the NSAI runs a certified airtightness tester scheme and in the UK ATTMA and BINDT run a competent assessors scheme on behalf of DCLG.
[5]S.I. 9 of 2014, http://www.irishstatutebook.ie/2014/en/si/0009.html
[6]ARA, Sinnott D., Dyer M., Air-tightness field data for dwellings in Ireland. http://hdl.handle.net/2262/61487 Sinnott and Dyer found that the results of pressurisation tests on 28 Irish houses built between 1944 and 2008 "challenge the perception that newer dwellings are more airtight than older dwellings".
[7]Extracted from map included in Lu, Xi and McElroy, Michael B. and Kiviluoma, Juha, Global potential for wind-generated electricity, PNAS 2009;106:10933-10938
[8] WHO, Guidelines for the Prevention of Tuberculosis in Health Care Facilities in Resource-Limited Settings, 1999
[9]See, for example, Prof Bill Keating's work on the links between excess winter morbidity and poor housing: http://news.bbc.co.uk/2/hi/health/5372296.stm
[10]There is no conflict between building airtight but to high levels of moisture vapour diffusion openness (often mis-named "breathability"). The two concepts are often confused. For a recent discussion on the differences, refer to Joseph Little's Retrofit in Ireland linkedin group: http://linkd.in/1s6WTo7
[11]http://www.greenbuild.ie/PassiveHouseBlowerDoorTesting.pdf
[12]The measured air change rate is 0.372 ACH (or 0.6 $m^3/hr/m^2$), significantly better than the Enerphit retrofit standard of 1.0 ACH and better than the full passive house standard of 0.6 ACH. It is an order of magnitude better than the backstop value under Irish building regulations for dwellings of 7.0 $m^3/hr/m^2$.

glossary

*Perplexed by all this talk of U-values, blower door tests and embodied energy? This latest instalment of our sustainable building glossary will help you get to grips with the key terminology. These entries will be added to an online glossary at **www.passive.ie/glossary**, which will continue to grow in detail as each new issue comes out.*

ACH (air changes per hour, or n50) One of two common ways that airtightness is measured via blower door pressurisation and depressurisation tests. It measures the number of times a building's volume of air changes in an hour, typically at 50 pascals of pressure. Passive house buildings must have airtightness of no greater than 0.6 air changes per hour. The other unit airtightness is often measured in is air permeability (or q50), which is expressed in $m^3/hr/m^2$.

Code for Sustainable Homes The UK's national standard for the sustainable design and construction of new homes. It aims to reduce carbon emissions and promote higher standards of sustainability above building regulations. It rates a build from levels one (the lowest) to six (the highest) based on nine criteria: energy/CO_2, water, materials, surface water runoff, waste, pollution, health and well being, management and ecology.

Condensing boiler A condensing boiler can re-capture some of the heat normally released in the form of hot gases, and use it to heat up water returning from the central heating system. This means that it requires less energy to produce a given amount of heat, and is therefore more efficient.

Demand controlled ventilation DCV systems provide ventilation to rooms based on their actual occupancy. Common systems on the market often employ a humidity sensor to detect the level of fresh air required. Carbon dioxide, volatile organic compound and motion sensors can also be incorporated into DCV systems.

Fabric first This is a design philosophy that emphasises reducing a building's energy consumption and CO_2 emissions by first making it well insulated and airtight before considering technologies like renewable energy systems.

Form factor The shape of a building. Buildings with a simple cuboid shape and a minimum number of joints and protrusions can more easily meet the passive house standard as they have less surface area from which heat can escape.

G factor (or solar factor/value) This measures the amount of heat gain that enters through a glazed unit on a scale from 0 to 1. The lower number, the less heat gain through the window. There is usually a trade off between light transmittance and the G factor.

MVHR (mechanical ventilation with heat recovery) A technology that ventilates a building while also recovering heat from extracted air. MVHR systems typically use electrical fans to extract warm, damp air from 'wet' rooms like kitchens and bathrooms and use it to heat cool, fresh incoming air, which is then piped to living spaces such as living rooms and bedrooms. Sometimes referred to as heat recovery ventilation (HRV).

OSB Oriented strand board is an engineered wood label product made from altered flakes or strands of wood oriented in specific directions. It is available in a variety of thicknesses, and when its joints are taped and sealed it is sometimes used as the airtight layer on timber frame projects. Though this approach is successfully taken on many passive house projects, it sometimes struggles to meet the highest levels of airtightness because the variable nature of the material leads to variable leakage rates.

Passive house Also known as Passivhaus, passive house is a rigorous ultra-low energy building standard, developed in Germany in the early 1990s. It emphasises the principles of super-insulation, airtightness and controlled ventilation. Passive house buildings are designed to be so energy efficient that they don't require conventional central heating. Passive house buildings make the most of free heat wherever possible – whether in the form of passive solar gains through windows, metabolic gains from occupants, or recovering most of the heat that would otherwise be lost venting hot, wet air from cooking or washing. The standard can apply to all building types, not just homes.

Photovolatic (PV) A method of generating electrical power by converting solar radiation into direct current electricity using semiconductors. Householders, businesses and other building occupants sometimes install solar PV panels to generate electricity for their own use and for exporting to the national grid. This is a free, natural and renewable source of energy.

PHPP (Passive House Planning Package) Software developed by the Passive House Institute that is used to design and certify buildings aiming to meet the passive house standard. It's often employed as a design tool for low energy buildings even if the architect or builder is not specifically aiming to meet the standard. Available from the Passive House Institute.

Psi (ψ) values This is the 'linear thermal transmittance', the rate of heat flow per degree temperature difference, per unit length, of a thermal bridge. It is measured in W/mK, and is used to calculate the heat loss or gain through a thermal bridge.

Service void A cavity, often used in timber frame elements but sometimes in other forms of construction, in which services such as piping and wiring are contained. The service cavity is sometimes packed with insulation to further improve the U-value of the wall or roof.

Thermal bridging Alternatively known as cold bridging, occurs when heat or cold transfers across an external surface of a building. This can cause heat to escape from the building or cold to enter. Thermal bridging occurs when a thermally conductive material (ie a material with low resistance to heat flow) penetrates or bypasses the insulation layer.

U-value The U-value of a material is the rate of heat loss through that material. The lower the U-value of a material, the less heat can pass through it and the better it is at insulating. U-values are measured in watts per metre squared kelvin (W/m^2K). Passive buildings typically have U-values of 0.15 W/m^2K or less for buildings elements like walls, roof or floor.

Vapour control membrane A material that is designed to significantly reduce the transfer of water vapour through a building element (eg wall or roof). They are often installed on the warm side of a construction to prevent water vapour from reaching the colder elements and condensing into liquid water.

Y-value This is a measure of heat loss through all the combined non-repeating thermal bridges of a building. Under Irish and UK building regulations, the individual Psi-values for each non-repeating thermal bridges are multiplied by the measured length of each bridge before a Y-value for the building can be calculated, expressed in W/m^2K.

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interactive

ASK Y

The development of our new Y-value calculator introduces an industry first, providing accurate Y-value calculations within house designs based on Xtratherm insulation solutions over default ACD values. Simply input your calculations to receive certified information specific to your project.

Fabric Energy Efficiency Standards (FEES) have been introduced for Part L compliance in 2014. FEES are about how we insulate our buildings in order to meet zero carbon standards. Yes, we improved the thermal performance of our insulation range, but it's not just about Lambda and U-Values anymore. It's about detailing how the insulation builds and interconnects with other components and elements within your design.

YOU MAY ASK:

- Why Xtratherm engineer joint their boards?
- Why all the emphasis is on detailing like pre-formed corner boards or insulated service voids?
- Why Xtratherm certify all their technical support team to provide accurate and reliable calculations?

It's simple: we deliver the most cost effective solution with the most efficient thermal bridging Y-values.

You achieve more when you ask Xtratherm Y.

Try it now! **www.xtratherm.com**